SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES

FOR the twelfth year statistics have been collected concerning the degrees of doctor of philosophy or of science conferred by the universities of the United States and the data are summarized in the accompanying tables. There were this year conferred 378 degrees, exactly the same number as last year, but an increase of more than 100 over the average of the ten preceding years. Details for these ten years will be found in the issue of SCIENCE for August 30, 1907. The number twelve years ago was scarcely over 200 and now has nearly doubled. Columbia this year conferred 59 degrees, which is the largest number so far from a single institution, and places Columbia before Harvard in the total number of degrees conferred in twelve years, 436 as compared with 418. Chicago with 448 stands first. Yale with 394 stands close to Harvard. The Johns Hopkins, which earlier was at the head of the list, has not maintained its position and is now in the group with Pennsylvania and Cornell. These seven institutions are decidedly before all others in their graduate schools, having conferred 2,579 degrees as compared with 892 by the thirty-five other universities. Among the state universities Wisconsin leads with 110 degrees followed by Michigan with 86 and California with 47.

The second table gives similar details for the natural and exact sciences. Exactly half of the degrees were this year in the sciences whereas in the first ten years covered by these statistics the percentage was 45. Chicago here also stands at the head

TABLE I

DOCTORATES CONFERRED

	Average of 10 years 1898-1907	1908	1909	Total for 12 years 1898-1909
Chicago	35.6	54	38	448
Columbia	32.2	55	59	436
Harvard	33.8	42	38	418
Yale	31.8	32	44	394
Johns Hopkins	30.5	28	27	360
Pennsylvania	22.5	32	29	286
Cornell	18.1	22	34	237
Wisconsin	8.6	17	7	110
Clark	8.7	11	9	107
New York	6.7	15	13	95
Michigan	6.9	4	13	86
Boston	4.4	11	13	68
California	3.3	4	10	47
Princeton	2.6	6	4	36
George Washington	2.8	3	4	35
Virginia	2.8	4	1	33
Minnesota	2.4	3	5	32
Brown	2.3	2	5	30
Bryn Mawr	2.1	4	2	27
Catholic	2.0	1	3	24
Nebraska	2.0	2	2	24
Stanford	1.4	2	3	19
Illinois	.5	5	4	14
Iowa	1.1	2	0	13
Georgetown	1.0	0	0	10
Vanderbilt	.6	1	1	8
Washington	.7	1	0	8
Missouri	.4	3	0	7
Colorado	.5	0	1	6
Indiana	.0	3	3	6
Massachusetts Institute	.3	3	0	6
North Carolina	.5	0	1	6
Cincinnati	.3	0	2	5
Northwestern	.4	0	1	5
Pittsburgh	.1	4	0	5
Washington and Lee	.4	1	0	5
Syracuse	.2	0	2	4
Kansas	.3	0	0	3
Lafayette	.3	0	0	3
Dartmouth	.1	1	0	2
Lehigh	.2	0	0	2
Tulane	.1	0	0	1
Total	271.5	378	378	3,471

TABLE II

DOCTORATES CONFERRED IN THE SCIENCES

	Average of 10 years 1898-1907	1908	1909	Total for 12 years 1898-1909	Per Cent.
Chicago	16.4	37	20	221	49
Johns Hopkins	16.8	17	20	205	57
Columbia	13.4	21	23	178	41
Harvard	14.1	13	14	168	40
Yale	12.4	16	27	167	42
Cornell	10.4	15	24	143	60
Pennsylvania	9.0	18	13	121	42
Clark	7.7	11	8	96	89
Wisconsin	2.8	6	1	35	32
Michigan	2.9	1	5	34	40
California	2.4	2	6	32	68
George Washington	1.7	2	2	21	60
Princeton	1.1	3	3	17	47
Brown	1.2	2	2	16	53
Nebraska	1.3	1	2	16	66
Stanford	1.1	2	2	15	78
Virginia	1.1	2	0	14	42
Bryn Mawr	1.0	1	0	11	41
Minnesota	.7	1	2	10	31
New York	.6	1	3	10	11
Washington	.7	1	0	8	100
Catholic	.5	—	2	7	20
Iowa	.7	0	0	7	54
Indiana	.0	3	3	6	100
Massachusetts Institute	.3	3	0	6	100
Illinois	.3	0	2	5	36
Missouri	.3	2	0	5	71
North Carolina	.3	0	1	4	66
Vanderbilt	.3	1	1	4	50
Washington and Lee	.3	1	0	4	80
Kansas	.3	0	0	3	100
Northwestern	.2	0	1	3	60
Boston	.1	0	1	2	3
Cincinnati	.1	0	1	2	40
Colorado	.2	0	0	2	33
Dartmouth	.1	1	0	2	100
Lehigh	.2	0	0	2	100
Georgetown	.1	0	0	1	10
Lafayette	.1	0	0	1	33
Syracuse	.1	0	0	1	25
Total	123.2	184	189	1,605	46

of the list, having overtaken the Johns Hopkins two years ago. At the Johns Hopkins 57 per cent. of all degrees have been in the sciences, at Cornell, 60 per cent.; whereas at Harvard the percentage is 40, at Columbia 41 and at Yale and Pennsylvania 42. This year just one third of the degrees at Harvard were in the sciences, whereas at Yale the percentage was 60. It is noticeable that sciences do not predominate in the state institutions, as would probably be expected. The percentages of degrees in the sciences for Wisconsin, Washington, California, Nebraska and Minnesota, respectively, are 32, 40, 68, 66 and 31. The change in the position of the leading universities in the number of degrees awarded in the sciences is indicated by the number of scientific men included among the leading 1,000 scientific men of

the United States,[1] who mostly received the doctor's degree prior to or at the beginning of the period covered by these statistics. The numbers are: Johns Hopkins, 102; Harvard, 57; Columbia, 38; Yale, 28; Cornell, 26; Chicago, 23; Pennsylvania, 12.

TABLE III

	Average of 10 years 1898–1907	1908	1909	Total for 12 years 1898–1909
Chemistry	32.0	54	39	413
Physics	15.5	22	25	202
Zoology	14.7	25	18	190
Psychology	13.4	23	21	178
Mathematics	12.1	23	13	157
Botany	12.6	11	16	153
Geology	7.1	5	11	87
Physiology	4.1	7	13	61
Astronomy	3.4	1	7	42
Bacteriology	1.4	1	5	20
Agriculture	1.0	2	7	19
Anthropology	1.0	4	4	18
Paleontology	1.6	1	1	18
Anatomy	.9	2	0	11
Pathology	.5	2	3	10
Mineralogy	.6	0	3	9
Engineering	.8	0	0	8
Metallurgy	.3	0	1	4
Geography	.1	1	2	4
Meteorology	.1	0	0	1
Total	123.2	184	189	1,605

	1908	1909	Total for two years
Economics	17	41	58
English	30	27	57
History	32	22	54
Philosophy	25	14	39
German	14	14	28
Romance Languages	12	14	26
Greek	13	11	24
Latin	12	12	24
Oriental	9	14	23
Education	6	9	15
Political Science	9	4	13
Sociology	6	5	11
Theology	7	2	9
Law	1	0	1
Music	1	0	1
Total	194	189	383

In the third table is given the distribution of the degrees among the different subjects. Chemistry, as always, is at the head of the list, but shows some decrease. Zoology and mathematics are also somewhat below their average, whereas physics and psychology are above; but such changes from year to year are not significant. A real tendency may, however, be indicated by the increased number of degrees in physiology, bacteriology, pathology, agriculture and anthropology.

The institutions which this year conferred two or more degrees in a science are: in *chemistry,* Yale, 7; Cornell and Johns Hopkins, 6 each; Harvard and Pennsylvania, 5 each; Columbia, 4; in *physics,* Cornell, Johns Hopkins, Pennsylvania and Yale, 3 each; California and Michigan, 2 each; in *zoology,* Columbia, 5; Harvard, 4; Chicago, 3; Johns Hopkins, 2; in *psychology,* Clark, 4; Columbia and Cornell, 3 each; Chicago and Harvard, 2 each; in *mathematics,* Johns Hopkins and Yale, 3 each; Chicago, Columbia and Harvard, 2 each; in *botany,* Chicago, 4; Cornell, 3; Michigan, 2; in *geology,* Chicago and Yale, 3 each; Cornell, Johns Hopkins and Michigan, 2 each; in *physiology,* Yale, 6; Columbia and Johns Hopkins, 2 each; in *astronomy,* California, Chicago and Indiana, 2 each; in *anthropology,* Clark, 3; in *agriculture,* Cornell, 5; in *mineralogy,* Columbia, 2. In other subjects, Columbia leads with 13 degrees in the political sciences. Harvard gave 8 and Columbia 6 degrees in English. The only other instance in which more than four degrees were given by a department was of five degrees in German at Chicago.

The names of those on whom the degree was conferred in the natural and exact sciences, with the subjects of their theses, are as follows:

YALE UNIVERSITY

Isaiah Bowman: "The Geography of the Central Andes."

[1] Cf. SCIENCE for December 7, 1906.

Horace Thomas Burgess: "Point-circle Correlations."

Charlton Dows Cooksey: "Corpuscular Secondary Röntgen Rays."

Arthur Wayland Dox: "The Intracellular Enzymes of Penicillium and Aspergillus, with especial Reference to those of Penicillium Camemberti."

Graham Edgar: "The Quantitative Estimation of Vanadium."

William Ruthven Flint: "The Complexity of Tellurium."

George Edward Gage: "Studies on the Biology and Chemistry of Nitroso Bacteria."

George Frederick Gundelfinger: "On the Geometry of Line Elements in the Plane with Reference to Osculating Vertical Parabolas and Circles."

Fred Harvey Heath: "The Iodometric Determination of Associated Copper, Arsenic and Antimony."

Warren Witherell Hilditch: "Studies on the Influence of Alcohol upon Metabolism."

Albert Wallace Hull: "Ionization produced by Ultra-violet Light of very short Wave-lengths."

Ellsworth Huntington: "Changes in Climate of recent Geological Time."

Israel Simon Kleiner: "Studies in Intermediary Metabolism—the Physiological Action of some Pyrimidines."

Leonard Merritt Liddle: "Studies in Pyrimidines and Research on Halogen Amino Acids."

John Franklin Lyman: "Experimental Studies on the Metabolism of the Purins in the Mammalian Organism."

David Ford McFarland: "Investigation of the Action of Alkyl Halides on some Mercapto Pyrimidines; and a Study of some Molecular Rearrangements in the Amidine and the Thiocyanacetanilide Series."

Victor Caryl Myers: "The Chemistry and Physiology of the Pyrimidines, Thymine, Cytosine and Uracil."

George Elwood Nichols: "A Morphological Study of *Juniperus communis* var. *depressa*."

Levi Fatzinger Noble: "The Geology of the Shinumo Area, Grand Canyon, Arizona."

Joseph Ezekiel Pogue, Jr.: "The Cid Mining District of Davidson County, North Carolina. A Region of Ancient Volcanic Rocks."

Thomas Edmund Savage: "The Stratigraphy of the Lower Paleozoic Formations in Southwestern Illinois."

Mary Davies Swartz: "Nutrition Investigations on the Carbohydrates of Lichens, Algæ and related Substances."

Thomas Smith Taylor: "The Retardation of Alpha Rays by Metal Foils and Gases; and its Variation with the Range of the Alpha Particles."

Edwin Ward Tillotson, Jr.: "On the Synthesis of Malonic Ester, with special Reference to the Influence of Catalytic Agents in the several Reactions."

Mary Shore Walker: "A Generalized Definition of an Improper Multiple Integral."

Hiram Lee Ward: "A Study of Metallic Oxalates, with special Reference to the Separation of Copper as the Oxalate."

Robert Day Williams: "A Study of Reaction Movements."

CORNELL UNIVERSITY

Frank Carney: "The Pleistocene Geology of the Moravia Quadrangle."

Charles Frederick Clark: "A Statistical Study of Variation in Timothy (*Phleum pratense*)."

Marshall Baxter Cummings: "Orchard Survey of Niagara County, New York."

Henry Platt Cushing: "Geology of the Thousand Island Region, New York."

Ludwig Reinhold Geissler: "The Measurement of Attention."

Arthur Witter Gilbert: "Studies of Heredity in Plants."

Clarence Frederic Hale: "Contributions to the Chemistry of Hydrazine."

Chester Deacon Jarvis: "American Varieties of Beans."

Harry Houser Love: "Studies in Variation."

Gustav Ernst Fredrick Lundell: "Anhydrous Hydronitric Acid."

Ellen S. McCarthy: "The Determination of Benzine in Illuminating Gas."

Louise Sherwood McDowell: "Some Electrical Properties of Selenium."

Joseph Vance McKelvey: "The Groups of Birational Transformations of Algebraic Curves of Genus 5."

James Oscar Morgan: "The Effect of Soil Moisture and Soil Temperature upon the Availability of Plant Food."

Taizo Nakashima: "Contributions to the Study of the Affective Processes."

William Henry Pyle: "An Experimental Study of Expectation."

Burton Justice Ray: "Some Trisazo Compounds of Resorcin."

John Moore Reade: "Studies in Sclerotinia."

Donald Reddick: "The Black Rot Disease of Grapes."

Ralph Cuthbert Snowdon: "The Electrolytic Reduction of Nitrobenzene."

John Houston Squires: "Studies of certain Properties of an Unproductive Soil."

Orin Tugman: "The Effect of Electrical Oscillations on the Conductivity imparted to Gases by an Incandescent Kathode."

Chauncey William Waggoner: "A Study of Some of the Physical Properties of a Series of Iron-carbon Alloys at the Temperature of Liquid Air."

John Anderson Wilkinson: "The Phosphorescence of some Inorganic Salts."

COLUMBIA UNIVERSITY

George Herbert Betts: "The Distribution and Functions of Mental Imagery."

Thomas Clachar Brown: "Studies on the Morphology and Development of certain Rugose Corals."

Chester Arthur Darling: "Sex in Diœcious Plants."

Walter Hollis Eddy: "The Synthesis of some Proteid Salts."

Ross Aiken Gortner: "On some New Quinzoline Derivatives."

Louise Hoyt Gregory: "Observations of the Life History of *Tillina magna*."

George Wilber Hartwell: "Plane Fields of Force Invariant under Projective Transformations."

Harry Levi Hollingworth: "The Inaccuracy of Movement (with special Reference to Constant Errors)."

Royal Preston Jarvis: "Investigations on Jigging."

Otto Kress: "Does Thorium exist as Thorium Silicate in Monazite?"

Alfred Hemmer Kropff: "Diaminoisophalic Acid and certain of its Derivatives."

Maurice Allison Lamme: "On the Specific Gravities of Niobium and Tantalum Pentoxides."

Alfred Peirce Lothrop: "The Effects of Bone Ash in the Diet on the Gastro-intestinal Conditions of Dogs."

Charles Searing Mead: "The Chondrocranium of an Embryo Pig, *Sus scrofa:* A Contribution to the Morphology of the Mammalian Skull."

Fernandus Payne: "Some New Types of Chromasome Distribution and their Relation to Sex."

Jacob Rosenbloom: "A Contribution to the Study of the Nature and Origin of the Bince Jones Protein; with Bibliography."

Edward Sapir: "The Takelma Language of Southwestern Oregon."

Charles Edward Taylor: "A New Rapid Volumetric Method for the Determination of Niobium in the Presence of Tantalum and its Application to the Analysis of Niobium Minerals."

Myron Owen Tripp: "Groups of Order p^3q^2. (February 16.)"

Harold Worthington Webb: "A Systematic Study of Electric Wave Vibrators and Receivers."

Maurice Francis Weinrich: "Rutherford Photographs of Stars surrounding B Cygni."

David Day Whitney: "Studies of Sex Determination and Sex Production in *Hydatina senta*."

Herbert Hollingsworth Woodrow: "A Quantitative Study of Rhythm: A Psycho-physical Investigation of Intensity and Duration in Rhythm."

UNIVERSITY OF CHICAGO

George Cromwell Ashman: "Studies in Radioactivity."

Walter Van Dyke Bingham: "Studies in Melody and Movement."

Robert Earle Buchanan: "The Morphology of *Bacillus radicola*."

Liborio Gomez y Pineda: "Studies in Rocky Mountain Spotted Fever."

William Duncan MacMillan: "Periodic Orbits about an Oblate Spheroid."

Wales Harrison Packard: "On Resistance to Lack of Oxygen in Animals."

Wanda May Pfeiffer: "The Morphology of *Leitneria Floridana*."

Alma Gracey Stokey: "The Anatomy of Isoetes."

Katashi Takahashi: "Histogenesis of the Lateral Line System in Necturus."

Sister Helen Angela Dorety: "Anatomy of the Seedling of Ceratozamia."

Arnold Dresden: "The Second Derivatives of the Extremal-integral."

Nielsine Johanna Kildahl: "The Morphology of Phyllocladus."

Edson Sunderland Bastin: "Chemical Composition as a Criterion in Identifying Metamorphosed Sediments."

Herbert Earle Buchanan: "Periodic Oscillations of Three Finite Masses about the Lagrangian Circular Solutions."

Thomas Buck: "Oscillating Satellites near the Lagrangian Equilateral Triangle Points."

Elwood S. Moore: "Geology of the Onaman Iron Range District."

Harvey Andrew Peterson: "The Influence of Complexity and Dissimilarity in Memory."

Marion Lydia Shorey: "The Effect of the Destruction of Peripheral Areas on the Differentiation of the Neuroblasts."

Clinton Raymond Stauffer: "The Relationship of the Middle Devonian Faunas of Ohio."

Harry Lewis Wieman: "A Study in the Germ Cells of *Leptinotarsa signaticollis*."

JOHNS HOPKINS UNIVERSITY

William Edward Burge: "Analysis of the Ash of the Normal and Cataractous Lens."

N. Trigant Burrow: "The Determination of the Position of a Momentary Impression in the Temporal Course of a Moving Visual Impression."

George Brownlee Clinkscales: "Effect of the Presence of a Chemically Inert Gas upon the Absorption Spectra of Sodium Vapor at Different Pressures and Densities."

James Ryals Conner: "Basic Systems of Rational Norm-Curves."

J. Frank Daniel: "Adaptation and Immunity of the Lower Organisms to Ethyl Alcohol."

Lucius Junius Desha: "On the Mechanism of Oxime Formation and Hydrolysis, and the Use of the Hydrogen Electrode in the Presence of certain Organic Compounds."

Eugene Edward Gill: "The Osmotic Pressure of Cane Sugar Solutions at 5°."

William Dana Hoyt: "Physiological Aspects of Fertilization in Ferns."

Clinton Maury Kilby: "Redetermination of the Wave-lengths of the Arc and the Spark-lines of Titanium, Manganese and Vanadium; the Effect of Capacity and Self-induction on the Wave-Lengths of the Spark-lines."

David Deitch Leib: "On a Complete System of Invariants of Two Triangles."

Charles Frederick Lorenz: "The Physical Properties of Flames when carrying Electric Currents."

Thomas Poole Maynard: "The Corrigans Formation of Maryland."

Sidney Nirdlinger: "I. On the Reactions of Diazoalkyls with 1-Phenyl-2-Methylurazole; II. On the Rearrangement of the Tautomeric Salts of 1, 4-Diphenyl-5-Thiourazole and 1, 4-Diphenyl-5-Thioendourazole."

Louis J. Rettger: "The Coagulation of Blood."

Asa Arthur Schaeffer: "Selection of Food in *Stentor cæruleus*."

Maurice Roland Schmidt: "Conductivity and Viscosity in Mixed Solvents containing Glycerol."

Joseph Theophilus Singewald, Jr.: "The Iron Ores of Maryland in the Piedmont and Appalachian Regions."

Edgar Apple Slagle: "On the Theory of Indicators and the Reaction of Phthaleins and their Salts."

Herman Ivah Thomsen: "Some Facts in regard to Plane Rational Curves."

Emanuel George Zies: "The Osmotic Pressure of Cane Sugar Solutions at 0°."

HARVARD UNIVERSITY

Frederick Stephen Breed: "Modifiability of Behavior in the Chick."

Laurie Lorne Burgess: "Thermochemical and Spectrographic Studies among the Metals."

Edgar Davidson Congdon: "Studies of the Effects of Alpha, Beta and Gamma Rays of Radium upon the Growth, Structure and Pigment Migration of Animals.

Joseph Augustine Cushman: "The Phylogeny of the Miliolidæ."

Louis Serle Dederick: "Certain Singularities of Transformations of Two Real Variables."

Harley A. Flint: "Certain Derivatives of Tetrabromorthobenzoquinone."

George Thomas Hargitt: "The Maturation, Fertilization and Segmentation of *Pennaria tiarella* (Ayres) and *Tubularia crocea* (Ag.)."

Richard Henry Jesse, Jr.: I. "A Revision of the Atomic Weight of Chromium." II. "The Heats of Combustion of certain Liquid Hydrocarbons."

Richard Everingham Scammon: "Normal Plates of the Development of *Squalus acanthias*."

Herbert Joseph Spinden: "Maya Art."

William Dunlop Tait: "An Experimental Study of Memory in Relation to Psychophysical Attitudes."

Edson Homer Taylor: "On some Problems in Conformal Mapping."

Hobart Hurd Willard: "A Revision of the Atomic Weights of Silver, Lithium and Chlorine."

Joaquin Enrique Zanetti: "On Furoylacetic Ester and its Pyrazolone Derivatives."

UNIVERSITY OF PENNSYLVANIA

William Henry Chapin: "Halide Bases of Tantalum."

Fanny Cook Gates: "The Conductivity of Gases Caused by certain Chemical Changes."

Charles McDowell Gillan: "A Study of Ammonium-phospho-molybdates."

Ben Leon Glascock: "Metallic Strontium."

Mary Bowers Hall: "Histogenesis and Histolysis of the Intestinal Epithelium of Bufolentiginosus."

Cassius Eugene Hiatt: "A Thermo-hysteretic Frequency Meter and the Application of Differential Thermo-junctions to A.C.-D.C. Comparison."

Marion Mackenzie: "Phyto-phenology—The Relation of Climate to Plant Life."

Stevenson Smith: "Studies in Educability."

Joseph Leasure Kline Snyder: "Double Fluorides of Titanium and of Zirconium."

Clara Harrison Town: "The Train of Thought —An Experimental Study of the Insane."

Walter Kurt Van Haagen: "Tantalum and some of its Halides."

Frank Wenner: "A Theoretical and Experimental Study of the Vibration Galvanometer."

Edgar Theodore Wherry: "Contributions to the Mineralogy of the Newark Group in Pennsylvania."

CLARK UNIVERSITY

John Franklin Bobbitt: "The Growth of Philippine Children."

Louise Ellison: "Consciousness in Relation to Learning."

Burton Noble Gates: "Biological Studies of the Honey Bee."

Hikozo Kakise: "An Experimental Study on the Conscious Concomitants of Understanding."

John Augustus Magni: "The Ethnological Background of the Eucharist."

Howard Washington Odum: "The Religious Folk-Songs of the Southern Negroes."

Eugene C. Rowe: "Voluntary Movement."

Inman Lyon Willcox: "The Psychological Aspect of Sin and Salvation."

UNIVERSITY OF CALIFORNIA

Simpson Leroy Brown: "The Residual of Inductance and Capacity in Resistance Coils, a Standard Resistance with Balanced Inductance and Capacity."

John Charles Duncan: "The Orbits of the Cepheid Variables Y *Sagittarii* and RT *Aurigæ;* with a Discussion of the Possible Causes of this Type of Stellar Variation."

Edward Arthur Fath: "The Spectra of some Spiral Nebulæ and Globular Star Clusters."

Arend Lourens Hagendoorn: "The Purely Maternal Character of the Hybrids produced from the Eggs of Strongylocentrotus."

Frederic Addison Harvey: "Atmospheric Radioactivity in California and Colorado and the Range of the Particles from Radium B."

Adolph Knopf: "Geology of the Seward Peninsula Tin Deposits, Alaska."

UNIVERSITY OF MICHIGAN

Walter Francis Colby: "Coefficient of Expansion of Nickel near its Critical Temperature."

Richard de Zeeuw: "Comparative Viability of Seeds, Bacteria and Fungi when treated with certain Chemical Agents."

Frank John Mellencamp: "Thermodynamics of Concentration Cells."

Leigh H. Pennington: "The Effect of Longitudinal Compression on the Production of Mechanical Tissue in Stems."

Lucas Petrou Kyriakides: "A Contribution to the Study of the Relation between Color and Constitution in the Triphenyl-methane Series."

INDIANA UNIVERSITY

William Edgar Howard: "Stellar Parallax."

Isaac McKinney Lewis: "The Chromosomes in Pinus and Thuja."

Vesto Melvin Slipher: "The Spectrum of Mars."

NEW YORK UNIVERSITY

Arthur Selwyn-Brown: "The Psychology of Evaluation."

Frederick E. Breithut: "The Partial Vapor Pressures in Binary Mixtures."

David Heidon Ray: "The Science of Mechanics."

PRINCETON UNIVERSITY

Lewis Robinson Cary: "The Life History of *Diplodiscus temporatus.*"

Bartholomew John Spence: "The Optical Properties of Colloidal Solutions of Gold, Platinum and Silver."

Charles Bell McMullen: "An Experimental Investigation into the Space Coordination of Different Senses."

BROWN UNIVERSITY

Paul Franklin Clark: "The Relation of the Pseudodiphtheria and the Diphtheria Bacillus."

Frederick George Keyes: "The Condensation of Meta-nitrophenylpropiolic Acid to Naphthalene."

CATHOLIC UNIVERSITY OF AMERICA

Richard Stephen Burke: "Theory of Comparison in Psychology."

Thomas Patrick Irving: "The Ultimate Source of the Spectrum."

GEORGE WASHINGTON UNIVERSITY

Harry Wilson Houghton: "The Effect of Cold Storage on Chicken Meat."

George Whitfield Stiles: "The Possibility of Shellfish Contamination from Sewage-polluted Waters."

UNIVERSITY OF ILLINOIS

Robert Stewart: "Quantitative Relationships of Carbon, Phosphorus and Nitrogen in Soils."

Ernest Shaw Reynolds: "Relations of Parasitic Fungi to their Host Plants."

UNIVERSITY OF MINNESOTA

Alois F. Kovarik: "The Effect of Changes in the Pressure and Temperature of a Gas upon the Velocity of the Negative Ions Produced by Ultra-violet Light."

William McDonald: "Agricultural Education."

UNIVERSITY OF NEBRASKA

Clarence Emerson: "The Relation of the Common Milk Streptococci to the Streptococcus Pyogenes."

Joseph Allen Warren: "Agricultural Geography of Nebraska."

LELAND STANFORD JUNIOR UNIVERSITY

John Pearce Mitchell: "The Normal Constituents of the Potable Waters of the San Francisco Peninsula."

Albert Christian Herre: "A Lichen Flora of the Santa Cruz Peninsula, California."

BOSTON UNIVERSITY

Guilielmus Henricus Watters: "The Opsonic Method of Treating Disease."

UNIVERSITY OF CINCINNATI

Robert E. C. Gowdy: "The Fatigue of Metals Subjected to the Roentgen Radiation."

UNIVERSITY OF NORTH CAROLINA

Stroud Jordan: "Condensation of Chloral with Primary Aromatic Amines."

NORTHWESTERN UNIVERSITY

Harold Stiles: "A Determination of Wave-length of the Arc and Spark Spectra of Mercury."

VANDERBILT UNIVERSITY

Allan Fulson Odell: "A Spectographic Study by Means of a Grating (Replica) Spectroscope, and the Determination of the Wave-lengths of the Arc Spectrum of Tantalum."

UNIVERSITY OF WISCONSIN

Willibald Weniger: "Infra-red Absorption Spectra."

DURER'S "CONTRIBUTION" TO GESNER'S NATURAL HISTORY

THE statement that Dürer "contributed" one or more drawings to Gesner's famous "Natural History" was called to my attention many years ago, when the error appeared to be sufficiently obvious, but not having the proper materials then in hand, it was not traced to its source.

Attention was again directed to the subject by a recent history of biology, in which it is stated that "his (Gesner's) friend supplied one of the originals—the drawing of the rhinoceros." Again in a delightful essay on Gesner, written some years ago by a revered teacher and friend, we are told that "the names of very few of the draughtsmen and engravers" of the "History" are known, but Gesner says that Lucas Schrön drew the birds, and that Albrecht Dürer made the cut of the rhinoceros.

This suggests that Dürer was not only the author of the engraving, but that he actually made it for Gesner's work, and this impression is confirmed when we read farther on of "His contemporary and friend, Dürer."

The truth of the matter is easily set forth. Albert Dürer made the original of the rhinoceros picture, but he did not "contribute" it to the "Historia Animalium," nor was he strictly a contemporary, or in any sense a friend of the author.

When Albrecht Dürer (1471–1528) died, a world-famous artist, Conrad Gesner (1516–1565) was a lad of twelve, and the "Historia Animalium" (1551–1558) did not begin to appear until nearly forty years after the engraving of the rhinoceros was made and published. Gesner simply borrowed this plate, and in accordance with his commendable custom, acknowledged it in a descriptive note or legend placed beside the cut. Dürer's name here appears for the first, and so far as I have

ascertained, for the only time, in the History. A hasty or imperfect reading of this legend undoubtedly led to the error. The legend freely translated reads as follows:

This is a picture by Albert Dürer, in which that illustrious painter (whose works on drawing still exist) depicts most admirably the Rhinoceros sent to Emmanuel, king of Portugal, at Lisbon, in the year of grace 1515, from the district of Cambay in India. I have lately seen a painting of a Rhinoceros, that is the Nose-horn, representing an animal of this kind, which was recently sent to the king of Portugal from India, and Augustus Justinianus has with certainty identified this very drawing which we here reproduce as a true likeness.[1]

The meaning towards the close of the last sentence is rather obscure. What is literally said is: "Aug. Justinianus recognizes unquestionably this very likeness which we here give." Apparently Gesner intended to say that he had recently seen a painting (presumably from life) of the rhinoceros in question, or of one like it, and that Augustin Justinianus, who had probably seen the animal alive, vouched for Dürer's sketch as a true likeness. Dürer's fame as an artist was sufficient guaranty for the drawing as a work of art, but Gesner wished to make it clear that it was a good likeness and therefore of scientific value also. This is the best interpretation which we can give. The meaning could hardly be that this drawing of Dürer's was a good likeness of the painting referred to, for Gesner had seen both and would be as good a judge as any.

This was the first Indian rhinoceros (*R. unicornis*) to be seen alive in Europe since the days of the Roman amphitheatres, and it naturally created a great sensation. It was sent to Lisbon in 1513, and not in 1515, as stated by Gesner, and without doubt by one of those Portuguese generals who were then making important conquests in India. Possibly more than one of these animals was imported at about this time, the first of which is said to have demolished its cage while on the journey. Emmanuel is further reported to have sent a rhinoceros in the same year (1513) to Pope Leo X., and to have also matched one in a fight with an elephant, in which the latter was worsted.

"Aug. Justinianus," the now somewhat mysterious authority referred to by Gesner, was without doubt the Augustin of that name (1470–1536), at one time bishop of Nebbio in Corsica, and again professor in the University at Paris, a celebrated Oriental scholar, divine and writer of the period. He may have been a friend of Gesner, and at all events had evidently seen the animal referred to alive.

Several artists may have tried their skill in delineating this novel animal, and one at least in the capacity of friend or admirer sent Dürer a description of the beast and enclosed a sketch of it. From these data, and not from a description alone, as has been often asserted, Dürer composed his now famous drawing, which was engraved on wood and first published in 1515. Dürer's original drawing is preserved in the British Museum, and bears on its lower margin, in the artist's own hand, a note, which in translation reads as follows:[2]

Item in the year 1513, on May 1, they brought our King of Portugal at Lisbon such a beast

[1] For the benefit of any who may wish to consult the original, I give the text of the legend as it stands in the first edition of Gesner: "Pictura haec Alberti Dureri est, qua clarissimus ille pictor (cuius etiam libri de pictura extant) Rhinocerotem Emmanueli Lusitaniae regi anno salutis 1515, è Cambaia Indiae regione Ulysbonam allatum, perpulchre expressit. Rhinocerotis, id est naricornis, nuper pictam vidimus imaginem, referentem ex hoc genere animal, quod per haec tempora Lusitano regi ex India allatum est, Aug. Justinianus hanc ipsam indubiè, quam hic damus, imaginem intelligens." Conradi Gesneri medici Tigurini Historiae Animalium, Lib. I. de Quadrupedibus viviparis. ("De Rhinocerote," p. 952.) Tiguri apud Christ. Froschoverum. Anno M. D. L I.

[2] In addition to assistance received from various friends in the elucidation of certain questions, I desire to specially acknowledge the courtesy of Mr. J. L. Farnum, of the Library of Congress, for supplying the translation of the Dürer inscription and other interesting notes pertaining to this subject.

alive from India, which they call a Rhinoceros. For the wonder's sake I have had to send you a likeness of it. It has a color like a tortoise and is covered nearly all over with thick scales, and in size is like the elephant but lower, and is the elephant's mortal enemy. It has in front on its nose a strong sharp horn, and when the beast comes at the elephant to fight him it has always first whetted its horn sharp against the stones, and runs at the elephant with its head between his forelegs, and rips him up where he has the skin thinnest and so kills him. The elephant is very badly afraid of the rhinoceros, for it kills the elephant whenever it comes at him, for it is so well armed, and very lively and active. This beast is called "Rhinoceros" in Greek and Latin, but in Indian, "Ganda."

In writing this inscription Dürer simply copied the most pertinent extracts from the letter of his correspondent at Lisbon. The original, like so many of Dürer's letters, was probably destroyed, for nothing of it appears in Thausing's work on the artist's literary remains.[3]

According to Hausmann five different editions of Dürer's cut of the rhinoceros appeared, distinguished by varying German text, besides those in other languages. The Library of Congress possesses an impression of the seventh edition with inscription in Flemish, and a reproduction of the first German edition. The translation of this German edition follows closely that on the original drawing, omitting only the last sentence, in which the names of the animal are given. The Flemish inscription also follows the German of the drawing and of the woodcut, with the exception of the following statement:

This Rhinoceros mentioned above was sent by the King to Germany, to the Emperor Maximillian, and was drawn from life by the renowned Albrecht Dürer, as here represented.

Both of these statements are erroneous, and are curiously contradicted by Dürer's own note to which they are appended.

The remark that this animal was sent to the Emperor of Germany has been repeated by other writers, but is refuted "by the unanimous testimony of the Portuguese historians, Barros, Correa and Albuquerque the Younger, who stated that Manuel sent the creature, on account of its rarity, to the Pope (Leo X.), but that it perished by shipwreck before reaching Rome." Heller in his life of Dürer also discredits the statement, since no mention of the fact is made either in the German inscription, quoted above, or in the life of Maximillian.

Gesner must have read the printed inscription on Dürer's original engraving, of which he made use, but he either did not have it at hand, or used a trimmed copy when writing the note for his History, for he misdates it, and gives additions from other sources.

It must be admitted that Dürer's interesting engraving is a poor likeness of the subject, being faulty in proportion, in the shape and pose of the head, as well as in the remarkable tattooing or ornamentation of the skin. For this, however, the great artist and lover of animals is not to be blamed. Buffon, who gives an account of all the early pictures of this animal, remarks that no really accurate drawings or descriptions of this species existed prior to the publication of a "Natural History of the Rhinoceros" by Dr. Parsons in 1743. The animals which this careful naturalist studied were sent to London in 1739 and 1741, the former coming from Bengal. Buffon considered Dürer's drawing one of the poorest, and remarks upon the most ancient pictures of "nose-horn" extant as follows:

Those indeed which we see on the ancient pavements of Praeneste and on the medals of Domitian are extremely imperfect; but at least they are without the imaginary ornaments of that of Albert Dürer.

Dürer was without any doubt an enthusiast on natural history, and it is to be noted that he made a hurried, and as it proved, fatal journey to Zealand to sketch a stranded whale. His engravings were widely disseminated, and while good impressions of the subjects have become exceedingly rare and valuable, that of the rhinoceros does not seem to have been greatly sought after by collectors. The original plate is large, measuring within lines

[3] "Dürers Briefe, Tagebücher und Reime," Moriz Thausing, Wien, 1872.

11¾ × 8¼ inches; in the upper right corner is fixed the word "rhinocerus," between the date "1515," and the well known bold monogram of the artist; there is a scant foreground, and the detailed inscription was added outside the enclosing lines. The impression which the present writer has before him is printed on thin linen paper bearing the water-mark of the peacock, well known to dealers and collectors, and is trimmed to the lines, according to the pernicious custom of an earlier time.

Gesner properly used this print, which must have been common in his day, duly acknowledged it, and added a brief history of the subject for the interest of the general reader. The reproduction, possibly by Gesner's own hand, is almost photographic in accuracy, excepting the accessories of enclosing lines and foreground, which were studiously omitted from nearly all of his illustrations. It was reduced by about one fourth, and was naturally reversed in printing. Although Gesner might have advantageously drawn still further from the great Neurenburg artist for admirable pictures of horses, dogs, stags and hares, he refrained.

FRANCIS H. HERRICK

THE UNITED STATES BUREAU OF EDUCATION

THE Bureau of Education at Washington, which has occupied for thirty-seven of the forty-two years of its existence the rented building at the corner of Eighth and G streets, northwest, was removed in July to the second floor of the old Post-office Department building between Seventh and Eighth and E and F streets, with storage and mailing rooms in the basement. Its new quarters are more commodious and much more comfortable than the old. This is the first time in the history of the bureau that it has been quartered in a government building.

A measure of reorganization in the staff of the bureau was made during the month of July. Mr. Lewis A. Kalbach, who has been connected with the bureau for twenty-two years and has served during the past three years as clerk to the Commissioner, in addition to his duties as specialist in land-grant college statistics, has been appointed chief clerk of the bureau. He has been succeeded as specialist in land-grant college statistics by Professor James E. McClintock, of the University of Maine, whose principal work will have to do with the relations of the federal government with the land-grant colleges of agriculture and mechanic arts. The former chief clerk, Mr. Lovick Pierce, continues his connection with the bureau as chief of the correspondence division. Dr. Harlan Updegraff, who has served as chief of the Alaska division during the past two years, has been appointed collector and compiler of statistics, succeeding Mr. W. Dawson Johnston, who has been made librarian of Columbia University. Dr. Updegraff's principal duties will have to do with the relations of the bureau with the chief school officers of the several states and cities of the country. It is expected that he will serve as an adviser in matters affecting school administration.

Mr. William T. Lopp, who has served as district superintendent of schools in Alaska, has been appointed superintendent of education of natives of Alaska and will have direct charge, under the supervision of the commissioner of education, of education and the reindeer industry among the Alaskan natives. He will divide his time between Alaska and Washington and will have charge of the Alaska division of the bureau.

Some time will be taken in closing up the special work upon which Dr. Updegraff and Mr. Lopp are now engaged, in the Alaska service, and it is expected that they will not enter their new duties before November or December.

Arrangements have been made by the Bureau of Education and the Bureau of the Census for the collection by special census agents of financial statistics of the school systems of the larger cities. The statistical form used by the Census Office will be furnished shortly by the Bureau of Education to a number of these cities that can not be reached this year by the census agents. This form is the outcome of a conference between the two offices concerned.

It is still in an experimental stage, but its use by the Census Office and the Bureau of Education is expected to develop any defects or weaknesses in it, and lead to the adoption of a form that will meet the conditions existing in the various cities of the country.

Another forward step has been taken as regards the prompt issuance of the Annual Report of the Commissioner of Education. On certain conditions, which can undoubtedly be met, the public printer has agreed to furnish bound copies of Volume 1 of the Annual Report for 1909 on December 1 of this year, and volume 2 on March 1 of the year 1910. In view of this arrangement, it may now be confidently expected that the first volume, containing general surveys, directories, etc., will be in the hands of readers before the convening of those educational associations which meet during the holiday season; and the second volume, containing the statistical tables, will be received prior to the Easter vacation meetings.

ELMER ELLSWORTH BROWN,
Commissioner

WASHINGTON, D. C.,
August 9, 1909

SCIENTIFIC NOTES AND NEWS

AT a meeting of the Board of Geological Survey of Michigan in Detroit on August 9, Professor R. C. Allen, of the University of Michigan, was elected state geologist to succeed A. C. Lane, whose resignation to accept a chair in Tufts College we announced a month or two ago. Professor Allen had received the endorsement of five out of six of the board of scientific advisers.

AT the celebration of the fifth centenary of the University of Leipzig a large number of honorary degrees were conferred, including a doctorate of medicine on Professor E. B. Wilson, of Columbia University, and a doctorate of philosophy on Professor Jacques Loeb, of the University of California.

AT its recent celebration the University of Geneva conferred one hundred and fifty honorary doctorates. Among the men of science included were Lord Lister, Professor Haeckel, Professor Ostwald and Professor Engler.

DR. H. W. WILEY, chief of the Bureau of Chemistry, has had conferred on him the Cross of the Legion of Honor by the French government.

DR. J. C. KAPTEYN, director of the observatory at Groningen, has been elected a corresponding member of the Paris Academy of Sciences.

THE Baly medal, awarded by the Royal College of Physicians of London every alternate year for distinguished services to physiology, has been awarded to Dr. Emil Fischer, professor of chemistry in the University of Berlin; and the Moxon medal, awarded every third year for distinguished services to clinical medicine, has been awarded to Sir W. R. Gowers, F.R.S.

THE Berlin Academy of Sciences has awarded its Leibnitz medal in gold to M. Ernest Solvay, of Brussels, and to Dr. C. von Böttinger, of Eberfeldt.

THE Santaro prize of $2,000 of the Accademia dei Lincei of Rome has been awarded to Professor Quirino Majoranna for his researches in wireless telegraphy.

DR. ISADOR ROSENTHAL, professor of physiology at Erlangen, has celebrated the fiftieth anniversary of his doctorate.

THE following professors have retired from active service: Dr. Georg Gerland, professor of geography at Strasburg; Dr. Friedrich Prim, professor of mathematics at Würzburg, and Dr. Anton Grünwald, professor of mathematics at Prague.

DR. WALTER LEHMANN, of Berlin, has been appointed curator in the Munich Ethnographical Museum.

DR. BREINL, of the Liverpool School of Tropical Medicine, has been appointed director of the newly-founded School of Tropical Medicine in Western Australia.

DR. J. FRANKLIN MEYER, formerly professor of physics at the Pennsylvania State College, State College, Pa., has resigned his professorship to accept a position with the Westinghouse Lamp Company, Bloomfield, N. J., in charge of the physical research.

The Experiment Station Record states that John B. Thompson, for several years connected with the Bureau of Agriculture of the Philippine Islands, has been appointed special agent in charge of the Guam Station, with H. L. V. Costenoble as assistant. Considerable material has been received for the erection of the station buildings. Experimental plantings of forage and other crops from seed secured from the mainland and Hawaii have been begun by the station, and seeds have also been distributed to farmers and others for trial.

WILLIAM BLUM, Ph.D. (Pennsylvania), late assistant professor of chemistry at the University of Utah, becomes assistant chemist in the Bureau of Standards, assuming office on September 1.

PRESIDENT IRA REMSEN, of the Johns Hopkins University, is in California engaged in studying the question whether the "sulphuring" process renders fruit unwholesome.

PROFESSOR F. B. CROCKER, of the electrical engineering department of Columbia University, has leave of absence and starting in October will make a trip around the world.

DR. M. C. SMITH, of Lynn, Mass., sailed on July 23 for Europe to attend the fifth International Dental Congress, of which he is an honorary president, to be held in Berlin the last week in August, and the International Medical Congress at Budapest.

THE University of Tubingen has celebrated the centenary of the birth of the celebrated geologist, Friedrich August Quenstedt.

THE University of Rochester, Rochester, N. Y., has received under the provisions of the will of the late Rear Admiral William Harkness, professor of mathematics, U.S.N., almost his entire large and valuable collection of astronomical and scientific instruments, and a considerable part of his library. The instruments, including an Alvan Clark telescope, comprised the equipment for a private observatory he intended to erect. The devise of books included over 1,600 volumes, and about 7,000 unbound periodicals and pamphlets. The university has placed the works on astronomy and physics in a separate section of its library, as the basis of a scientific department, to be known as the Harkness Scientific Library.

DR. MILLIKEN STALKER, for many years head of the department of veterinary science of Iowa College, has died at the age of sixty-seven years.

DR. O. FRÖLOCH, who took an important part in the development of electrical machinery in Germany and as lecturer at the Charlottenburg Technical School, has died at the age of sixty-six years.

DR. JOHANNA MESTORF, until recently director of the Museum for National Antiquities at Kiel, has died at the age of eighty years.

THE deaths are also announced of Dr. A. Fraser, professor of anatomy in the Royal College of Surgeons, Dublin, and of Dr. W. Ritz, docent for physics at Göttingen.

THE tenth annual meeting of the Astronomical and Astrophysical Society of America opened at the Yerkes Observatory, Williams Bay, Wisconsin, on Wednesday evening, August 18.

THE Society for Horticultural Science will hold its annual meeting at St. Catharines, Ontario, Canada, on Monday, September 13, immediately preceding the meetings of the American Pomological Society, which occurs on September 14, 15 and 16. The Welland Hotel will be headquarters for the society. The program will be one of the best which the society has ever had. Dr. L. H. Bailey, of Cornell University, will discuss "The Field of Research Work in Horticulture." Dr. E. W. Allen, of the Office of Experiment Stations, Washington, D. C., will discuss "The Adams Fund in its Relation to Investigations in Horticulture." Dr. H. J. Webber, of Cornell University, will outline the work being carried on there under the Adams Fund Act and Professor S. B. Green, of St. Anthony Park, Minnesota, will outline the work being done under this act at the University of Minnesota. There will be several other papers, but these have not been definitely arranged for at this time.

A Bristol County Academy of Sciences, situated at Taunton, has been organized and incorporated under the laws of Massachusetts. It is proposed to establish a museum with collections selected especially to illustrate the local fauna and flora, to establish a library and reading room, to conduct a laboratory if possible, to maintain a bureau of information, to provide lectures and to issue publications. The president is Mr. Henry F. Bassett, the secretary Mr. A. Cleveland Bent and the curator Mr. Frederic H. Carpenter.

The attendance at the New York Aquarium during July was 528,266, an average of 17,040 per day. The total attendance for 1909 to August 2 has been 2,006,919.

The University of Utah archeological expedition that is making excavations and studies in the San Juan country reports that it has secured a large quantity of material and has been successful in its investigations. Byron Cummings, dean of the school of arts and sciences, is in charge of the expedition. During the coming year he will pursue archeological studies in New York and in Europe.

The junior class in mining engineering of the Case School of Applied Science spent the month of June studying the mines, mills and geology of the Black Hills, near Deadwood, Lead and Terry. The students were accompanied by Dr. A. W. Smith, professor of metallurgy, Dr. Frank R. Van Horn, professor of geology and mineralogy, and Mr. R. R. Abbott, instructor in mining engineering. During July, Professor Van Horn, with a few of the party, spent over two weeks in the Yellowstone National Park, entering by way of the Cody, Wyoming, road over the Sylvan Pass, and returning through Gardiner, Montana.

We learn from the London *Times* that the collection of fossil Brachiopod shells made by the late Mr. John Francis Walker, F.G.S., of York, has lately been presented to the British Museum (Natural History) by his executors. It represents the life-work of Mr. Walker, who formed it with the special intention of illustrating the nature of animal species and the laws governing the change of one species into another. He chose Brachiopods for his purpose on account of their abundance in the rocks of all geological ages, and arranged them in groups to exhibit their variations round certain apparently central forms. The collection consists of several thousand specimens chiefly from the English Jurassic and Cretaceous formations, and will be kept for the most part in the original cabinets in the Department of Geology, near the well-known Davidson collection. Some of the more important specimens, especially those described by Davidson, will shortly be exhibited in the public gallery. The case containing the okapis has been enriched by the addition of the skeleton of the animal whose mounted skin, presented by Major Powell-Cotton, is also shown. The two other specimens are the original female, presented some years ago by Sir Harry Johnston, and a male presented by Captain Boyd Alexander. In the upper gallery a very fine specimen of the Tibetan langur (*Rhinopithecus roxellanæ*) has just been put out. This curious monkey, distinguished at once by its "tip-tilted" nose, was discovered by Père David and described by Milne-Edwards. Near the entrance to this gallery is a young flying lemur (*Galeopithecus volans*) mounted on a tree stem to show its protective coloration. To the fish and reptile gallery the leathery turtle (*Dermochelys coriacea*), taken at Pwllheli last summer, has been added. It was impossible to preserve the animal, so that only the carapace and skeleton are shown.

On July 21 Lord Monk Bretton, as reported in *Nature*, asked in the House of Lords what steps had been taken to define the spheres of the Boards of Agriculture and Education, respectively, in the matter of agricultural education. At the same time he referred to the memorandum recently issued by the Board of Education, which implied that a sum of £21,000, in part at any rate, is available for agricultural education. He stated that he has been in communication with the university authorities and others, and can find no evidence that the money is used for this purpose. Similarly, the Treasury grants and the block-

grant system of the Board of Education have not helped agricultural education; money from the latter source, indeed, goes to the relief of the rates. British agriculture, he pointed out, receives much less money than the amount granted in foreign countries, a result due to the absence of agreement and coordination between the Board of Education and the Board of Agriculture. Earl Carrington, in reply, stated that an understanding had that morning been arrived at by the two boards as to the general lines of their future policy. There will be direct cooperation in regard to educational work, and in particular with the view of improving and extending specialized agricultural instruction. An inter-departmental committee of officers of the two boards will consider the questions that may arise as to the correlation of work and of grants. Everything is working harmoniously between the two departments. Lord Belper strongly urged that any arrangement between the two boards should follow the recommendation of the Agricultural Education Committee that agricultural education provided by colleges, farm institutes and winter schools should be under the direction of the Board of Agriculture, while agricultural instruction given at evening classes connected with elementary schools should be under the Board of Education. The Marquis of Lansdowne emphasized the great importance of the subject. Quoting Sir Horace Plunkett's dictum, that what is wanted in these days is not merely economic holdings, but an economic system and an economic man to carry it out, he went on to say that we can not get the economic man to carry out the economic system unless the government takes some pains to give him a proper education.

FROM her state forests France derives an annual income of approximately five million dollars, or $1.75 per acre. Eighteen per cent. of the entire area of the country, or 23,500,000 acres is forest land. Approximately six million acres are managed by the state, the annual cost of management being ninety-five cents per acre. The great achievement of France in forestry has been the establishment of protective forests where much destruction has been caused by floods. Toward the close of the eighteenth century about 2,500,000 acres comprised in the Department of the Landes were little more than shifting sand dunes and disease-breeding marshes. This section is now one of the richest, most productive and healthful in France. This change has been brought about by the intelligent cultivation of pine forests. Immense forests now cover the country, the sand dunes and marshes have long since disappeared, and the wood, charcoal, turpentine, rosin and kindred industries have brought prosperity to the department, which was formerly the most barren and miasmatic in France. The climate is now mild and balmy, the great change being wrought by the forests. The thin layer of clay beneath the sandy surface, formerly impervious to water, has been so pierced by the roots of the pine that there is now thorough drainage to the spongy earth below. The manufacture of rosin, tar, turpentine, pitch, pyroligneous acid and wood vinegar is conducted about the same as in Georgia and the Carolinas. The trees destined for "short life" are bled as soon as they are big enough to stand bleeding, when they have a circumference of a foot or fifteen inches, the sapping of young trees being the only production of a new forest for a time, and when the "thinning out" time comes they are "bled to death," and the timber used largely for pit props, the English demand guaranteeing a steady and profitable market. The "standing trees," those giving promise of most vigor, are never tapped until they are about three feet in circumference. When these have reached the age of fifty or sixty years they are cut down, and utilized for telegraph poles and railway ties. To prevent the spread of forest fires, wide trenches are dug about limited areas, and the space kept clear.

THE Society of Anthropology, Paris, has celebrated, in the great amphitheater of the College of Medicine, the fiftieth anniversary of its foundation. M. Bayet, director of higher education at the Ministry of Public Instruction, presided, and a great number of

delegates from France and foreign societies were present.

UNIVERSITY AND EDUCATIONAL NEWS

We learn from the *Experiment Station Record* that the legislature of Minnesota has passed an act providing state aid for ten high schools or consolidated rural schools which maintain agricultural and industrial departments. The state will pay two thirds of the expense to maintain these departments provided that each school employs trained instructors in agriculture, manual training, and domestic science, possesses not less than 5 acres of land suitable for school gardens and experimental and demonstration purposes, and that the total expenditure for each school does not exceed $2,500. The ten schools selected are the high schools at Albert Lea, Alexandria, Canby, Glencoe, Hinckley, Red Wing and Wells, the high schools and associated rural schools at Cokato and McIntosh and the consolidated school at Lewiston. The act also provides that not to exceed ten schools may be added to the list during each succeeding biennium.

The assembly of Iceland has decided to establish a university at Reikjavik, with four faculties and sixteen professors and lecturers.

The number of students in the universities of the German empire has this summer reached 51,700, an increase of about 3,000 over last winter and of 4,000 over the summer of 1908. There has been a large increase in the faculties of medicine and philosophy and a decrease in the faculty of law.

G. W. Stewart, A.B. (DePauw, '98), Ph.D. (Cornell, '01), has been elected professor of physics and head of the department at the State University of Iowa, to fill the vacancy caused by the removal of Professor Karl E. Guthe to the University of Michigan.

At the University of Wisconsin, Mr. E. E. Eldridge, of New York, a graduate of Cornell University, has been appointed assistant in bacteriology. Mr. Albert I. Stevenson, Massachusetts Institute of Technology, has been made chemist in the State Hygienic Laboratory connected with the university. In the engineering college faculty Mr. Charles G. Buritt, '09, Mauston, has been appointed instructor in railway engineering, and W. C. Muhlstein, '09, Grand Rapids, assistant in the same department. J. A. Cutler, '09, Dodgeville, is instructor in topographical engineering. George B. Blake, '08, Huron, S. D., and S. S. Hovey, a graduate of Iowa State College, are new assistants in electrical engineering. B. S. Wood, who was formerly instructor in wood work, is now instructor of pattern work.

The following changes in the faculty of the University of Utah are announced: Frank A. McJunkin, M.D. (Michigan), now instructor in bacteriology at the University of Michigan, succeeds Ross. Anderson, M.D., as professor of bacteriology and pathology and becomes state bacteriologist and pathologist; R. B. Ketchum, C.E. (Illinois), at present chief engineer of the Kansas and Colorado Railroad Co., becomes assistant professor of civil engineering; A. A. Knowlton, A.B. (Bates), A.M. (Northwestern), now associate professor of physics at Armour Institute, succeeds L. W. Hartman, Ph.D., as associate professor of physics; Wm. H. Chamberlin, A.B. (Utah), A.M. (California), becomes lecturer in philosophy, and Kenneth Williams, B.S. (Pennsylvania), now chemist for the Tintic Smelter, becomes instructor in chemistry.

Dr. I. M. Lewis, instructor in botany in New Hampshire College, has been appointed instructor in botany in the University of Texas.

The Belfast University commissioners have made the following appointments in the Queen's University, Belfast: *Professorships*—Botany: Mr. D. T. Gwynne-Vaughan, M.A. Cantab., formerly lecturer in botany, Glasgow University and Birkbeck College, London. *Lectureships*—Organic chemistry: Mr. A. W. Stewart, D.Sc. Glasgow, lecturer in stereochemistry and assistant to Professor Sir W. Ramsay, University College, London. Physics: Mr. Robert Jack, M.A., D.Sc., Ph.D. Glasgow and Göttingen. Bio-chemistry: Mr. J. A. Milroy, M.A., M.D. Edinburgh, demonstrator of physiology, Queen's College, Belfast. Geology and geography: Mr. A. R. Dwerry-

house, M.Sc., D.Sc., F.G.S., assistant lecturer in geology, Leeds University. Hygiene: Mr. W. J. Wilson, B.A., M.D., R.U.I., Riddell demonstrator of pathology and bacteriology, Queen's College, Belfast.

DR. ARTHUR ROBINSON, professor of anatomy in the University of Birmingham, has been called to the chair of anatomy in Edinburgh University, rendered vacant by the death of Professor D. J. Cunningham.

Nature is informed that the appointments to the chairs of chemistry in the Technical High School at Munich have just been officially announced. The names of the professors are: Organic chemistry, Professor Semmler; inorganic chemistry, Professor A. Stock; physical chemistry, Professor R. Abegg. Each professor has an institute of his own, and Professor Abegg retains, at the same time, his position as extraordinary professor in the University of Breslau. The Technical High School, which is being built at a cost of something like five million Marks, is making good progress, and is to be opened officially in October, 1910.

DR. F. RINNE, professor of mineralogy at Kiel, has been called to Leipzig.

DISCUSSION AND CORRESPONDENCE

TELEGONY AS INDUCED REVERSION

DARWIN and many other students of heredity have believed in telegony, and have collected many alleged examples. The typical instances were the striped colts produced by mares that had previously borne quagga hybrids.[1] The original theory of telegony assumed that the stripes of the later colts were inherited from the quagga sire of the first colt. Various attempts have been made to show how this could come about, but they were not able to secure scientific credence.

The tendency shown in Thomson's "Heredity" and other recent handbooks is to deny telegony altogether and to treat the alleged cases as ordinary instances of reversion. In Morgan's "Experimental Zoology" telegony is dismissed as "another breeder's myth," and is used as an illustration of the "credulity of men who have not been trained as to the value of evidence."

It is curious that this zeal for evidence allowed the fact to be overlooked that Darwin knew of three striped colts following quagga hybrids, instead of only one. This oversight may be partly responsible for the verdict reached in Professor Morgan's discussion of the supposed single case: "There was, then, merely a coincidence, and not a causal connection."

The additional evidence collected by Ewart has bearing upon the nature of the facts that have been grouped under telegony, but it does not explain the occurrence of such phenomena as sequels of hybridization. To reckon the striped colts as examples of reversion affords no proper warrant for denying any connection with the fact that the mares had previously borne quagga colts, or for assuming that such reversions are without scientific interest or practical importance. To know that characters of remote ancestors are likely to return to expression in progeny that follow hybrids may be quite as significant, from the standpoint of heredity, as the idea of long-range transmission from the male parent of the hybrid.

Before pronouncing telegony a myth, a further possibility should be taken into account, that the stripes of a later colt may be induced by the previous contact with the quagga, not through any form of transmission or "infection" with character-units or primordia from the quagga, but by giving a stronger tendency to expression to a primitive characteristic already included in latent form in the reproductive cells of the female. In his hybrids between zebras and horses Ewart found that the stripes were not like those of the striped parent, but of a much more complex pattern, indicating that a primitive character of some remote ancestor came into expression, instead of a character directly transmitted from the zebra. Ewart does not use his evidence to prove that striped colts following hybrids are mere coincidences, but to show that the theory of long-range transmission from the male parent is unnecessary.[2]

[1] "The Variation of Animals and Plants under Domestication," Chapter XI.

[2] Ewart, J. C., "The Penycuik Experiments," 1899.

Many external and internal conditions which do not appear to affect the *transmission* of characters are able to influence the *expression* of characters. Differences of heat and light, as well as of foods, chemicals and internal secretions (enzymes) are now known to induce changes in the expression of characters. Without the thyroid gland the remainder of the body does not complete its growth. Castrated animals may grow to abnormal size, but fail to develop secondary sexual characters. Parasitic fungi, insects and mites induce the development of galls and other changes in the habits of growth of their host plants. Horticulturists have learned that scions have definite influences upon the characters of the roots on which they are grafted. Plants grown under new and unaccustomed conditions often show wide ranges of individual variation, recalling many ancestral characters to expression. There is no ground for denying the possibility that similar reversions might follow impregnations by diverse types.

The fact that Ewart found only faint stripes on colts that followed his zebra hybrids does not destroy the older evidence that more vivid stripes, as well as peculiarities of mane and hoofs, followed the earlier instances of hybridization with the quagga, an animal of a different species, now reckoned as extinct. Atavistic changes have been found to be more frequent and more pronounced in some series of hybrids than in others, even in the same group of organisms. When our United States Upland cottons are crossed with the Kekchi cotton of Guatemala the hybrids have lint shorter than either parent, but when the Kekchi cotton is crossed with the Egyptian the lint is as long as in the Egyptian parent, or even longer. With hybrids, as with the parent stocks, external conditions often appear to have a definite influence upon the expression of characters. Hybrids of the same parentage may show Egyptian habits of growth under some conditions and Kekchi habits under others.[1]

[1] "Suppressed and Intensified Characters in Cotton Hybrids," Bulletin 147, Bureau of Plant Industry, U. S. Department of Agriculture.

The frequent occurrence of stripes in mules may also mean that hybridization has a tendency to induce this form of reversion. There is no reason to suppose that the stripes come from the asinine ancestry alone. Striped mules seem to be especially common in tropical countries, where unfavorable climatic conditions and the mixing of the breeds of horses may further increase the tendency to reversion. A vividly striped mule of a yellowish, zebra-like ground-color, seen at Cordoba, Mexico, a few years ago, gave me a better appreciation of the extent to which such reversions may sometimes be carried. The conspicuous markings of the legs happened to be seen first, the more uniform body of the animal being concealed by a wagon. I stepped into the street expecting to find a traveling managerie.

The possibility of bringing telegony into relation with other induced forms of reversion adds nothing, of course, to the evidence that reversions are induced by previous hybridization. Facts may establish theories, but theories do not establish facts, except as they lead to further observation. If enough reversions of the same kinds are found to occur without previous hybridization it will be reasonable to view all the alleged cases of telegony as coincidences. If reversions prove to be more frequent after hybridization telegony will be established, though its manifestations may not be otherwise different from reversions that occur without hybridization.

Negative evidence may show that induced reversions are rare, but does not affect the authenticity of particular cases, as Ewart himself perceived. Xenia also has appeared to be very rare in nature at large, but its frequent occurrence in maize is no longer doubted, and an explanation has been found in double fertilization, enabling the endosperm as well as the embryo to share the characters of the male parent. We need not feel obliged to discredit facts like those collected by Darwin and other students of heredity merely because an erroneous theory suggested the name telegony.

Pearson's plan of proving or disproving telegony by a statistical study of the degrees

of resemblance of children to fathers rests more on mathematical ideas than on biological indications, to judge from Thompson's account of it. To show that later children resemble their fathers more than earlier children would not demonstrate a cumulative paternal influence, but might only mean that children of older parents have less tendency to vary from parental characters than children of young parents. It would still be necessary to show that the paternal resemblances of the later children increase more than their maternal resemblances.

O. F. COOK

WASHINGTON,
April 30, 1909

SCIENTIFIC BOOKS

A Comparative Study of the Thorax in Orthoptera, Euplexoptera and Coleoptera. By R. E. SNODGRASS. *Proc. Ent. Soc. Washington,* IX., 1908, pp. 95–108, pls. II.–V.

The Thoracic Tergum of Insects. By R. E. SNODGRASS. *Ent. News,* March, 1909, pp. 97–104, pl. VI.

The Thorax of Insects and the Articulation of the Wings. B. R. E. SNODGRASS, of the Bureau of Entomology, U. S. Department of Agriculture. No. 1687—Proceedings U. S. National Museum, Vol. XXXVI., pp. 511–595, with plates 40–69. Published June 18, 1909.

The series of memoirs, under the above titles, constitutes a very valuable addition to the literature of insect structure. The last paper contains the detailed evidence for the theories presented by the other two and is really considerably broader than the title indicates, including an elaborate discussion of the segmentation of the head and abdomen and is not limited to a study of adult structure.

The diagrams (Figs. 1–6) present in an extremely satisfactory manner the author's views on the structure of the thorax, and the "glossary and synonymy" (on pp. 570–583) will prove more than ordinarily useful to subsequent students of this subject. Many will agree heartily with the protest against the tendency to explain all structural differentiation of a segment by the supposition of a multiple origin. It is pointed out that if segments have been lost they have been suppressed and not fused and are not represented by the present subdivisions of the segments.

There may be less assent to the idea of separating the labial segment from the head, there would be more reason for considering the prothorax as not forming part of the thorax. Much is added to our knowledge of the detail of the sternal and pleural structures, but nothing added to the interpretation of their significance beyond the accumulation of evidence against their supposed double origin and in favor of the single origin urged by myself several years ago[1] and the elevation of the occasionally partially chitinized articular membrane to the position of a component part of the segment under the names of the presternum and preepisternum.

In reference to the notum we find the most radical views. This region is conceived of as consisting of two parts, one the original chitinized portion of the segment, the other a new sclerite resulting from the chitinization of the articular membrane. This last portion is identified as the postscutellum of Audouin, the division between other three regions of the notum are supposed to be of relatively recent origin and not to be homologous through the group, since they do not correspond with a system of internal ridges which are considered as comparable in all insects.

It is probable that in some groups many authors have made mistakes in properly homologizing the various parts of the dorsum, but there has not yet been offered enough evidence to cause us to overturn at once the older nomenclature.

The scutum is the piece bearing the wing processes. Exactly what its anterior border is may be a question for discussion. Posteriorly it is probably bounded by the "V-shaped ridge," but here again we may have an unsettled question. The piece behind the scutum is the scutellum. There is no difficulty in most cases in recognizing it, but its exact boundary may again be an unanswered ques-

[1] "The Wing Veins of Insects," Univ. of Calif. Publications, Entomology, Vol. I.

tion. It is to be regretted that the author did not bring out the homology of these two great regions of the notum and devote his energies to the determination of the real boundaries of these regions.

The interpretation of the origin of the post scutellum or pseudonotum, as he calls it, was suggested by myself in the paper previously referred to, though I can not agree in considering this region belonging more to the segment in front than to the segment behind, particularly when the phragma is considered as part of this interpolated sclerite.

The great dorsal muscle of flight for which the phragma was developed is probably only a dorsal intersegmental muscle. These extend from the anterior edge of one segment to the corresponding part of the next. The anterior phragma is mesoprescutal, the posterior is a part of the first abdominal segment. The hymenoptera appear to be an exception in regard to the position of the first abdominal segment, only because of the great constriction between the first and second segment.

It may be impossible on anatomical grounds to locate the division between segments after the articular membrane has become wholly chitinized. The phragma may be, as this author says, a "chitinization of the infolded intersegmental membrane," but if so, why is not the deepest point of the fold the point of demarkation between the segments?

A more reasonable position would seem to be that the infolding for the attachment of intersegmental muscles marks the posterior boundary of the prescutum that the phragma belongs therefore entirely to the following segment and that with the completion of the chitinization of the articular membrane, the division is lost somewhere immediately anterior to the phragma.

The region designated by this author as pseudonotum developed as a chitinization of the articular membrane is probably therefore made up of two elements, one of which is continuous with the prescutum of the following segment.

The articulation of the wing has been studied in much detail, but scarcely anything is added to the work of Amans except the application of the Comstock-Needham nomenclature to the veins. The veins are said to be "connected or associated in a very definite and constant manner with the sclerites of the wing base," but speaking of the chief vein in the wing he says: "The base of the radius is nearly always more or less closely fused with the base of the subcosta but it is clearly connected also in a great many cases with the anterior end of the second auxiliary. In other examples its head is only contiguous to the third auxiliary." This does not seem to be very definite nor constant.

The study of the articulation throws but little light on the question of the homology of the veins because of the fact that in all orders except Odonata and Ephemerida, the basal connection of the veins has been disturbed to enable the wing to fold back against the body. Indeed the basal connections of the veins are very unreliable and are not depended on by any one in the determination of the homologies of the veins.

The presenting of theories is condemned by the author in numerous places and this article is offered as an accumulation of facts and conclusions, but it is very difficult to see the distinction. Theories in truth constitute the whole of science. Facts are nothing unless they mean something, and our interpretation of that meaning is what we really present. A drawing is at best a crude representation of the object and its only use is to represent our theory of what we see. The present paper contains over two hundred excellent drawings with very full explanations which will enable subsequent students to comprehend exactly what the interpretation of the structures were and I feel sure that in most particulars they will concur with his conclusions.

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A Short Handbook of Oil Analysis. By Augustus H. Gill, S.B., Ph.D. Fifth Edition. Philadelphia, Lippincott & Co. $1.50.

A book on chemical analysis which has five editions in twelve years is very nearly beyond criticism; fault finding is disapproved in advance, and praise is but gilding the re-

fined gold of royalty. But a man so generally popular as Dr. Gill gets all the praise that is good for him, anyway; so it may be observed that there are some things in which this book may yet be improved. The illustrations are better than none, but not much; and the directions for using flash-test apparatus are not quite as complete as a beginner ought to have. It should always be remembered that a metallurgical or cement chemist, for example, skilled in using ordinary apparatus, may know nothing at all about a flash-test; and it is in little details that the manipulation of the expert excels and has its greatest value. In most cases the directions given in this book are full and clear.

The inclusion of refractive indices would probably be generally approved, since the refractometer has come into general use. In general, the book would be better if there were more of it; and while its value is partly due to leaving out information not useful to the analyst, some further remarks as to the nature of the various oils, as well as to changes produced by reagents, from one so experienced as the author, would be of much use to the student.

Somewhat more than half of the book is given to physical and chemical tests; then there are descriptions, including preparation, uses, tests and constants for the chief petroleum products, for seventeen vegetable and nine animal oils, and certain waste fats and greases. There is an appendix of tables and other information. The book has been largely rewritten and has a good index; it appears to be free from typographical errors.

A. H. SABIN

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for May presents two papers, and notes: "The Categories of Variation," by S. J. Holmes, in which the author discusses the differences between fluctuating variations and mutations; going to some length in the analysis of elementary species, retrograde varieties and fluctuations, as distinguished by De Vries; with the general conclusion that the evidences, so far presented, do not sufficiently distinguish between unstable mutations and fluctuations. "The General Entomological Ecology of the Indian Corn Plant," by S. A. Forbes. "Notes on Some Recent Studies on Growth," by Raymond Pearl; "Cuénot on the Honey-bee," by T. H. Morgan; "Poulton and Plate on Evolution," by V. L. K[ellogg].

The American Naturalist for June presents four papers, and notes: "Heredity and Variation in the Simplest Organisms," by H. S. Jennings. "The Color Sense of the Honey-bee: is Conspicuousness an Advantage to Flowers"? by John H. Lovell; with the adduced evidence that the query is to be answered affirmatively. "Variation in the Number of Seeds per Pod in the Broom, *Cytisus scoparius*," by J. Arthur Harris. His conclusion is that for this species variability due to habitat is not more noticeable where it is introduced than where it is native. "Present Problems in Plant Ecology." These are presented in two articles read before the Botanical Society of America at the Baltimore meeting, 1908: (1) "The Trend of Ecology," by Henry C. Cowles, and (2) "Present Problems of Physiological Plant Ecology," by Burton E. Livingston. Under "Notes and Literature" V. L. K. makes note, under the heading of Evolution, on the retirement of Ernst Haeckel from his chair in the University of Jena, with emphasis upon the establishment and care of his new Phyletic Museum. He also notes the recent German discussion of mechanical versus vital basis for explaining phenomena of nature. George H. Shull notes the literal translation into French of Hugo De Vries's "Species and Varieties: their Origin by Mutation." J. F. McClendon presents a note on "The Totipotence of the First Two Blastomeres of the Frog's Egg."

SPECIAL ARTICLES

ON THE CONNECTION BETWEEN STIMULATION AND CHANGES IN THE PERMEABILITY OF THE PLASMA MEMBRANES OF THE IRRITABLE ELEMENTS

EVIDENCE of a varied and highly conclusive kind now exists that the phenomena of stimu-

lation in irritable or contractile tissues depend primarily on a temporary and readily reversible increase in the permeability of the surface films or plasma membranes of the constituent cells or elements. This evidence is essentially as follows.

1. Those motile organs and tissues in plants where movement is due to changes in the turgor of the cells present perhaps the clearest case (osmotic motile mechanisms: sensitive plants, *Dionæa,* stamens of Cynareæ, etc.). In *Mimosa pudica* (*e. g.*) the movement results directly from a sudden loss of turgor in the pulvinus cells, due to the escape of a fluid containing considerable dissolved matter. This effect indicates very clearly a sudden increase in the permeability of the protoplast in relation to the dissolved substances of the cell-sap. Movement in these plants is excited by the usual stimulating agencies and is accompanied by an electrical change or "negative variation" similar to that observed in the irritable tissues of animal during stimulation (Burdon-Sanderson). These conditions show (1) that in resting cells, at least of turgid plants, the normal state is one of almost absolute impermeability to the dissolved crystalloid substances within the cell combined with free permeability to water—otherwise the maintenance of turgor would be impossible; and (2) that during stimulation this semi-permeability is temporarily lost.

2. In animal cells the evidence of increased permeability during stimulation is less direct. That in this case also a high degree of impermeability characterizes the plasma membranes is shown by the phenomena of plasmolysis, by the inability of many dyes to enter the living cell, and by the failure of many dissolved crystalloid substances (sugars, neutral salts) appreciably to enter the suspended cells in fluids like blood (Hedin's researches). That stimulation is associated with an increase of permeability is indicated by the fact that most stimulating agencies (heat, various chemical substances, mechanical action, electrical shocks) also visibly increase the permeability of pigment-containing cells like blood-corpuscles, as shown by their laking action. Direct evidence of increased permeability during strong stimulation is also seen in certain favorable organisms, *e. g., Arenicola* larvæ (see below).

3. Evidence that semi-permeable membranes are concerned in stimulation is seen in Nernst's proof that the stimulating action (s) of alternating currents decreases with an increase in the number of alternations per second according to an apparently quite definite rule ($s = i/\sqrt{m}$, where i = intensity of current and m number of alternations). This indicates that changes in ionic concentration at the semi-permeable surfaces of the irritable tissue—*i. e.,* at the plasma-membranes—are an essential condition of electrical stimulation. A corollary of this theory is that if during stimulation the permeability is increased so that the semi-permeability of the membranes temporarily vanishes, stimulation should become temporarily impossible; the existence of a refractory period is thus indirect, but strong evidence of a marked increase in ionic permeability at the height of stimulation.

4. The assumption that stimulation is associated with an increase in the permeability of the semi-permeable membranes also explains the characteristic electrical phenomena of irritable tissues. If the irritable element, *e. g.,* muscle-cell, be regarded as a concentration-element in which the potential-difference between exterior and interior is due to a separation of ions at the plasma membrane, which is assumed to be readily permeable during rest to certain cations (probably hydrogen ions) but not to anions (Ostwald-Bernstein "membrane-theory")—the sudden fall of the demarcation-current potential during stimulation (negative variation or action-current) is at once explained by assuming that at this time the membrane becomes freely permeable also to anions. Free permeability to ions during stimulation is indicated by the refractory period, as already pointed out. The increase in permeability following death or injury is accompanied by an electrical change similar to that associated with stimulation—a fact which

again supports the view that permeability is temporarily increased during stimulation.

5. A close inorganic parallel to certain characteristic phenomena of stimulation is seen in the pulsating mercury hydrogen peroxide catalysis of Bredig and his collaborators. The electrical rhythm accompanying the rhythm of oxygen-evolution has been shown by Antropoff to run parallel with the formation and dissolution of a surface-film of mercury peroxidate. Here we have apparently an actual instance of a rhythmical change of potential which is due to rhythmical alteration of a surface-film; the marked resemblance in time-relations and in other respects to many rhythmical processes in organisms supports the view that a similar surface-change is the basis of the electrical variations accompanying automatic rhythmical stimulation in living tissues. The alternate formation and dissolution of the film over the mercury surface would correspond respectively to the alternate decrease and increase of permeability in the living cells.

The following special observations and experiments, made chiefly during the past summer at Woods Hole, furnish, it is believed, strong confirmatory evidence of the truth of the above general view. The organisms used were the larvæ of the annelid *Arenicola cristata,* which are readily obtainable in large quantity at Woods Hole. These are bitrochal larvæ *ca.* 0.3 millimeters in length with three setigerous body-segments; they swim actively by their cilia, showing pronounced positive phototaxis, and have a well-developed muscular system; and the cells are remarkable for containing large quantities of a water-soluble yellow pigment. This substance serves as an index of increased permeability by diffusing at such times from the cells and coloring the medium; such loss of pigment occurs during intense stimulation, after death, or under the influence of cytolytic substances (chloroform, etc.), but not during the normal activities of the animal; the phenomenon indicates therefore an abnormally great increase of permeability.

When *Arenicola* larvæ are transferred from sea-water into pure isotonic solutions of various alkali and alkali-earth salts (*e. g.*, NaCl, KCl, NH_4Cl, LiCl, CsCl, RbCl, $SrCl_2$, $BaCl_2$) they contract strongly to almost half the normal length and remain contracted for several seconds. During this interval the yellow pigment diffuses freely from the cells and colors the solution. Isotonic $CaCl_2$ and $MgCl_2$, on the other hand, have no such intense stimulating action and cause no loss of pigment; in these solutions the larvæ remain straight and extended and muscular movements cease (anesthethic action). Addition of a little $CaCl_2$ (1 volume $m/2$ $CaCl_2$ to 24 volumes $m/2$ NaCl) to isotonic NaCl solution prevents the initial stimulating action of the pure salt and at the same time the loss of pigment; in this mixed solution larvæ remain living and active for greatly prolonged periods (antitoxic action of Ca ions). Both the stimulating action and the toxicity of the pure sodium salt are thus associated with a marked increase of permeability; if this last is checked, as by the presence of appropriate bivalent cations (Ca, Mg, etc.), the two former effects also disappear. Solutions of $MgCl_2$ and similarly acting salts and anesthetics appear, on the contrary, to *decrease* the normal permeability. Stimulation is thus associated with an increase and inhibition with a decrease of permeability.

The electrolytes affect permeability presumably by influencing the state of aggregation of the colloids composing the plasma membrane. The consistency of the latter may also be changed by altering the condition of its lipoid constituents. It was found that relatively strong solutions of lipoid-solvents in sea-water, or even in $m/2MgCl_2$ solution (one half to one third saturated chloroform; saturated ether or benzole), also produce strong muscular contractions accompanied by loss of pigment. Solutions of this concentration are rapidly destructive to the larvæ; in *lower* concentrations the lipoid-solvents have the opposite action, checking activity (anesthetic action) without stimulation or loss of pigment. In general, the lipoid-solvents in *low* concentration appear to decrease permeability and hence temporarily to suspend activity without toxic action (anesthesia); in

higher concentrations they stimulate strongly, cause visible increase of permeability, and show pronounced toxicity. It would thus appear that marked increase of permeability, if prolonged for more than a short time, is highly injurious to cells—presumably on account of the diffusion of essential protoplasmic constituents to the exterior and the resulting chemical disorganization. Decrease of permeability, on the other hand, can have no such injurious effect, but merely checks interchange of material across the plasma membrane for the time being.

In isotonic sugar solutions muscular contractility is gradually lost. On transfer to solutions of various electrolytes contractions return. Of the pure solutions of the alkali salts the most favorable in restoring contractility are those of sodium; lithium and cæsium, while less favorable, resemble sodium in their general action; rubidium and potassium produce temporary contractions, but are much more toxic than the others. The order of increasing favorability for the cations is thus: K and Rb < NH_4 <Li < Cs < Na. The various sodium salts vary in their action according to the nature of the anion; the order of increasing favorability for anions is: I<Br<NO_3 (and ClO_3) <Cl<HPO_4<$C_4H_4O_6$< SO_4<$COOCH_3$. Of the alkali earth chlorides $MgCl_2$ produces no return of contractions; $CaCl_2$ and $SrCl_2$ cause slight contractions lasting some time; $BaCl_2$ almost immediately destroys all muscular contractility.

In explanation of the above effects it is assumed that in the non-electrolyte solution the normal permeability is decreased; hence the inhibitory or anesthetic action. The above electrolytes, by their action on the colloids of the plasma membrane, increase the permeability of the latter and so stimulate. On this interpretation, *any* substance which alters the plasma membrane in the direction of increased permeability should *ipso facto* restore contractility in larvæ from sugar-solution. It was found that weak solutions of acids (HCl, H_2SO_4, $HCOOCH_3$ in concentrations of n/3,200 to n/12,800) in isotonic sugar solutions restore almost normal contractions for a certain time. Acid causes also marked increase in the state of tonic muscular contraction. Alkali, on the other hand, has little power of restoring contractility, and induces decrease of muscular tone or lengthening. Weak acid thus appears to increase and alkali to decrease the permeability of the plasma membranes in larvæ from sugar solution.

Experiments on the influence of different electrolytes in restoring contractility in larvæ from isotonic $MgCl_2$ solution gave results essentially similar to the above, with the difference that the restorations of contractions by pure solutions of the above electrolytes is, as a rule, less readily effected. Presumably $MgCl_2$ solutions decrease the normal permeability to a greater degree than sugar; anesthesia appears more rapidly and is more profound in solutions of this salt than in those of dextrose or other sugar.

The question why increase of permeability should correspond to stimulation and decrease to inhibition is answered in essentially the following manner. It is assumed that during periods of increased permeability the loss of carbon dioxide from the cell will be more rapid than normal; the energy-yielding oxidative reactions of which this substance is the end-product are thus accelerated as a direct consequence of the increased rate of removal of the reaction-product from the system; hence the increased contractile activity or other energy manifestation during stimulation. Conversely, decrease of the normal permeability means decreased loss of carbon dioxide and hence retarded oxidation and energy-production; stimulation is more difficult at such times because of the greater difficulty of increasing the permeability to the critical degree required. This general view ascribes primary importance to the plasma membrane as probably the chief means by which the velocity of the oxidative energy-yielding reactions in the cell is varied. The promptness and vigor of the response to stimulation in highly irritable and active tissues like muscle are to be regarded simply as evidence of the high velocity with which the energy-yielding process, when unimpeded by the accumulation of reaction-products, proceeds in such cells. The grounds of this

high velocity are imperfectly understood at present. If we assume, however, that the reactions in the living cell progress rapidly to equilibria, and that in the resting cell, with a plasma membrane offering considerable resistance to the passage of CO_2, a condition of approximate chemical equilibrium prevails—it is clear that any disturbance of equilibrium, as by a more rapid removal of reaction-products (*i. e.*, CO_2), must be followed by a corresponding prompt acceleration of the reaction concerned. Such a system would respond to variations in the rate of removal of CO_2—*i. e.*, to variations in permeability—in a manner which under favorable conditions might well be very sensitive.

The *positive* electrical variation during inhibition (Gaskell)—as well as the negative during stimulation—receives consistent explanation on the membrane-theory if the polarizing electrolyte is assumed to be carbonic (with possibly other) acid. For further discussion the reader is referred to the complete paper in the *American Journal of Physiology*, Volume 24, April, 1909, page 14.

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WOODS HOLE, MASS.,
June 15, 1909

THE FORTIETH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fortieth general meeting of the American Chemical Society was held at the Detroit Central High School from Tuesday, June 29 to July 2, 1909. About 300 chemists were present, making this the most largely attended summer meeting in the history of the society.

On Tuesday evening the visiting chemists enjoyed a complimentary smoker given by the Detroit Society of Chemists.

On Wednesday afternoon and evening the visitors were guests of Parke, Davis & Co. In the afternoon the chemical laboratories were inspected and luncheon was served in the evening. This was followed by a moonlight ride on the river.

On Thursday morning a special train carried the visitors to Ann Arbor on the invitation of the regents of the University of Michigan. A subscription dinner was given at the Hotel Ponchartrain on Thursday evening.

On Friday excursions were made to the following manufacturing establishments: Acme Lead and Color Works, paints, white lead by new process; Morgan & Wright, auto tires and mechanical rubber; Detroit Salt Company, rock salt mine, 800 feet deep; Murphy Ice Company, distilled water, artificial ice—ozonizing plant in connection; Peoples' Ice Company, artificial ice plant; Packard Automobile Company; Detroit City Gas Company, manufacturers of illuminating gas; Cadillac Motor Car Company, auto manufacturers; The Herpicide Company; Goebel Brewing Company; Hiram Walker & Sons, distillery; American Electric Heater Company; Hoskins Manufacturing Company, pyrometers and electric furnaces; Sibley Quarry Company, limestone and sand-lime bricks; Peninsular Engraving Company, engravers and printers; The Clark Wireless Telegraphy Company, manufacturers of wireless equipment; Berry Brothers, varnish manufacturers; Detroit Iron and Steel Company, blast furnace.

The following papers were read before the general meeting:

Optical and Quartz Glass; their Chemical and Physical Properties: H. E. HOWE.

The Chemistry of Phosphorescing Solids: WILDER D. BANCROFT.

The following papers were read before the Section of Chemical Education:

A Place for Chemistry in the American College: ALEXANDER SMITH.

Some Ideals, Some Difficulties and a Compromise for a First Course in Chemistry: S. LAWRENCE BIGELOW.

A First College Course in Chemistry: ARTHUR JOHN HOPKINS.

College Chemistry beyond the Elementary Course: LAUDER W. JONES.

Laboratory Instruction in Industrial Chemistry: HARRY MCCORMACK.

Teaching by the Lecture System: NORMAN A. DUBOIS.

The following papers were read before the various sections:

BIOLOGICAL CHEMISTRY

Samuel C. Prescott, chairman

The Determination of Urea in Urine: F. W. GILL and H. S. GRINDLEY.

This paper gave the results of a somewhat complete comparative study of the Folin, the Benedict-Gephart and the hydrolysis-aeration methods for the determination of urea. The following are the most important conclusions: First, creatinine and hippuric acid are not at all decomposed by heat-

ing in the autoclave with hydrochloric acid, but they are partially decomposed either before or after treatment with hydrochloric acid in the autoclave by distillation with 20 c.c. of 10 per cent. sodium hydroxide solution. Second, uric acid is decomposed in part by the autoclave treatment with hydrochloric acid and, moreover, it is still further decomposed into ammonia by distillation with 20 c.c. of 10 per cent. sodium hydroxide solution. Third, the hydrolysis-aeration method purposed by the writers gives practically the same urea nitrogen values as does the Folin method, but the Benedict-Gephart method gives higher results than does the Folin method. The average of the analyses of twenty-five samples of urine in triplicate by the Folin method gave a value of 10.00 grams of urea nitrogen, while the hydrolysis-aeration method gave a value of 10.05 grams, and the Benedict-Gephart method gave a value of 10.25 grams of urea nitrogen per 24 hours. The results of the hydrolysis-aeration method expressed as percentage of the Folin results varied from 99.45 to 101.94 per cent., the average being 100.43 per cent. The results of the Benedict-Gephart method expressed as percentage of the Folin results varied from 100.88 to 103.86 per cent., the average being 102.52 per cent. Fourth, the hydrolysis-aeration method requires much less time and attention than does the Folin method and it does not require the expert manipulation and training necessary to get concordant results as does the Folin method.

Animal Nutrition. The Chemical Composition of the Wholesale Cuts of Beef from Three Animals: A. D. EMMETT and H. S. GRINDLEY.

This paper reported the results of the slaughter tests and the detailed chemical analysis of the regulation wholesale cuts of three steers and one calf. The four animals were of different ages and it was thus possible to determine the nature of the growth of the animal body at different stages of its development. From the analytical data obtained it was possible to calculate the weights of the following constituents: water; insoluble, soluble and total dry substance; insoluble, soluble and total protein; coagulable, non-coagulable and total soluble protein; nitrogenous, non-nitrogenous and total organic extractives; fat; insoluble, soluble and total mineral matter; and insoluble, soluble and total phosphorus—in the eleven wholesale cuts and the entire carcass of each of the four different animals.

The results clearly show that with an increase in the age of the animal there is a decrease in the percentage of the following constituents found in the animal body—water, soluble dry substance, soluble coagulable protein, soluble non-coagulable protein, total soluble protein, nitrogenous and non-nitrogenous extractives, and soluble phosphorus, but an increase in the percentage of the following constituents: total dry substance, fat, insoluble protein and insoluble phosphorus. A careful study of the data leads unmistakably to the conclusion that the cheaper cuts of meat in many instances have as high a food value as the more expensive ones. The cheaper cuts are just as wholesome, just as nutritious, and in every way just as good as the more expensive cuts, except that the latter give greater gratification to the palate. The data show that there are noticeable similarities and differences between animals of different age and breed—as to the weights of the bone, the visible fat, the lean meat and also as to the chemical composition of the edible flesh. The results of the chemical analysis indicate well-defined differences due to age and maturity, and marked differences between the wholesale cuts of a side of beef, and yet a noticeable similarity in the relative values of the corresponding wholesale cuts from different animals.

Urinary Creatinine of Men in Health: H. S. GRINDLEY.

A study of the urinary creatinine of a group of 24 men in apparently normal health, varying in age from 18 to 31 years and ranging in weight from 54.0 to 80.1 kilograms, was made for a period of 220 days. A varied and mixed diet consisting of fruits, cereals, vegetables, soups, meats, bread, milk, cocoa and sugar was supplied the members of the club. The ingested nitrogen varied from 10.6 to 15.8, the average being 13.3 grams per man per day. The lowest average individual creatinine value of the 24 subjects for the entire period of 220 days equaled 1.58 grams per day. The highest average individual creatinine value for the entire group for the same period equaled 2.25 grams per day. The average creatinine value expressed as grams per 24 hours for the twenty-four men for a period of 220 days equaled 1.85 grams. The creatinine values in the form of the so-called creatinine coefficients, that is, as milligrams of creatinine per kilogram of body weight, are as follows: minimum 24.4, maximum 31.5, average 28.1.

Folin first proved the fact "that the absolute quantity of creatinine eliminated in the urine on a meat-free diet is a constant quantity different for different individuals, but wholly independent

of quantitative changes in the total amount of nitrogen eliminated." The fact that the amount of creatinine excreted in the urine by a normal individual is quite independent of the amount of protein in the food, or of the total nitrogen in the urine, has been verified by many investigators. On the other hand, it seems to me that it is still a question as to whether or not the absolute quantity of creatinine eliminated even on a meat-free diet is a constant quantity for the same individual. Examination of Folin's results shows that between the minimum and maximum creatinine values for the same individual of a group of six normal men, during a period of five days, there are differences of 0.09 to 0.28 gram of creatinine per 24 hours, which differences amount to 6.4 to 22.9, the average being 13.32 per cent. of the minimum creatinine values. Again, for a group of six normal men during periods ranging from 9 to 16 days there are differences of 0.17 to 0.45 gram of creatinine per 24 hours, which differences amount to 15.6 to 35.5, the average being 21.0 per cent. of the minimum creatinine values. Shaffer for two individuals during periods of 8 to 25 days found differences of 0.24 and 0.37 gram of creatinine per day, which equals 19.8 and 26.6 per cent. of the minimum creatinine values. These variations, it seems to me, can not be considered insignificant.

The individual variations in the creatinine for the 24 subjects of this investigation, upon a diet containing meat, during a period of 220 days range from 0.50 to 0.99 grams per 24 hours, which equals 30.1 to 73.8 per cent. of the minimum creatinine values. These variations are apparently caused in the main at least by variations in atmospheric temperature; as a rule, other conditions being the same, the lower the temperature the smaller is the excretion of creatinine, and *vice versa*. The author is indebted to Professor A. P. Mathews, of Chicago University, for valuable suggestions in connection with this work.

A Study of the Food Requirements of a Group of Twenty-four Men: H. S. GRINDLEY and H. H. MITCHELL.

The detailed food requirements of a group of 24 men in apparently normal health, varying between 18 to 31 years of age and ranging between 54.0 and 80.1 kilograms in weight were accurately determined for a period of 220 days. A proper variety in diet, and, at the same time, a reasonable regularity in protein, carbohydrate and fat intake were secured by employing a carefully arranged eight-day menu. The protein actually consumed per individual varied from 67 to 99, the average for the 24 subjects being 85 grams per man per day. The grams of protein per kilogram of body weight varied from 1.11 to 1.44, the average for the 24 men being 1.28.

The maximum protein value of 99 grams obtained in this investigation is somewhat below the so-called Voit and Atwater standards of 100 grams for people doing light muscular work, but the average value of 85 grams is decidedly above any of the so-called minimum values of Chittenden, while the minimum value of 67 grams which is for a very light man weighing only 56 kilograms or 123 pounds compares closely with Chittenden's minimum values of 63 to 67 grams for men weighing upon an average 70 kilograms or 154 pounds.

The fuel value varied per individual from 2,584 to 3,685, the average for the entire group being 3,135 calories per day. The calories per kilogram of body weight ranged from 41 to 54, the average being 47. The carbohydrates actually consumed varied from 315 to 441, the average being 380 grams per man per day. The fat eaten varied from 94 to 192, the average being 131 grams per man per day.

Composition of the Fat of Beef Animals on Different Planes of Nutrition (first paper): C. R. MOULTON and P. F. TROWBRIDGE.

Fifteen to twenty fat samples from each of nine steers were investigated for moisture, fat and protein content, iodine value, saponification value and melting point. In the fatty tissue a high per cent. of fat is accompanied by a low per cent. of moisture and protein. The fat in the fatty tissue increases with fatness, the moisture with leanness. The fat per cent. in the fatty tissue increases from outside to inside while the moisture decreases. The iodine value of the fat increases with age, fatness and distance from the inside of the body, while the melting point falls.

Changes in the Composition of the Skeleton of Beef Animals (first paper): P. F. TROWBRIDGE and F. W. WOODMAN.

Seven steers were selected, all of nearly the same age and breed. They were fed to a good fat condition and one was killed as a check (when one year old). The others were put on the same rations (corn chop, linseed meal and alfalfa), varying in quantity so that two of the animals were on submaintenance, losing one half pound in weight daily. Two on maintenance and two on supermaintenance, gaining one half pound daily. One of each group was slaughtered after six months, the second submaintenance after eleven

months and the second maintenance animal after one year. Nine separate samples of the skeleton of each animal were analyzed. The results show that the principal effect of poor nutrition upon the skeleton is the removal of fat and its replacement with water, and that this effect is shown only after the fat is practically all removed from all other parts of the body. The mineral matter is practically unaffected by a long period of poor nutrition, and the same is true of the organic matter other than fat.

The Glycogen Content of Beef Flesh (first paper): P. F. Trowbridge and C. K. Francis.

The glycogen in the liver of beef animals is found as high as 3.8 per cent.; in the lean fresh muscle not to exceed two thirds of one per cent. The older animals show more glycogen than do the younger. Enzymatic hydrolysis of the glycogen takes place rapidly and probably accounts for much of the discrepancy of results. At 10° C. or less the enzymatic hydrolysis does not take place.

The Determination of Phosphorus in Flesh (first paper): P. F. Trowbridge.

A comparison of the amounts of phosphorus found in flesh by ignition to an ash and by digestion with sulphuric acid shows the same results by both methods. Phosphorus is not lost by ignition of flesh to an ash in open crucibles.

The following paper was reported by title:

A Review of Methods for the Estimation of Fat in Tissues: Waldemar Koch.

Agricultural and Food Chemistry

W. D. Bigelow, chairman
W. D. B. Penniman, secretary

Analysis of Citrous Oils: E. M. Chace and H. S. Bailey.

The principal constituents of oil of orange and oil of lemon, and their relative proportion in these oils, are briefly discussed. A short review of the present analytical methods applied to citrous oils for the purpose of detecting the more common adulterants is given. Owing to the increasing tendency to adulterate these oils with their own terpenes, the by-products from the manufacturer of the terpeneless oils and terpeneless extracts, it has become very important that we have some method for the detection of additions of these terpenes to normal oils. With this object in view, the vacuum distillation method has been employed and special apparatus constructed whereby it is possible to distill by means of the electric current 90 per cent. of the oil. The usual typical constituents of the original oil, when compared with those of the residual 10 per cent., have proved themselves valuable guides in the detection of these terpene bodies. A large number of authentic samples have been analyzed and work on the commercial oils of the country is now in progress. The exact data and results of these later investigations will be published at some future time.

The Distillation of Whisky: A. B. Adams.

Samples from different parts of a day's run were taken at two distilleries, one in Pennsylvania, where a three-chambered charge still is used for the distillation of the beer, and one in Kentucky, where the twelve or more chambered continuous beer still is operated. Samples of the beer, exhausted beer, of the leeswater and others representative of the different fractions of the distillation of the first and second distillations were analyzed. The results show that there is practically no fractionation in the distillation of whisky as practised in this country. It being shown that the product is separated into only two portions, first the distillate, second the exhausted beer or leeswater in the second still. The results prove that with the exception of a certain per cent. of acids and esters practically nothing is eliminated in the exhausted beer or leeswater. It was also evident that certain chemical changes occur in the acids, esters and aldehydes during the distillation.

A Volumetric Method for the Determination of Casein: L. L. Van Slyke and Alfred W. Bosworth.

To 20 c.c. of milk in a 200 c.c. flask, one adds about 80 c.c. of water and 1 c.c. of phenolphthalein solution. Then $n/10$ caustic soda is run into the diluted milk until a faint but distinct pinkish color remains after vigorous shaking. One then runs from a burette into the mixture $n/10$ $HC_2H_3O_2$, 5 c.c. at a time, shaking vigorously after each addition. The acid is run in until the casein separates promptly in large-sized flakes, leaving a clear supernatant liquid. It is best to have the mixture at a temperature of 65° to 75° F. before running in acid. Under these conditions, 30 c.c. of acid precipitates the casein in most milks. In some cases, only 25 c.c. may be required, while in some rare cases we have used 35 to 40 c.c. A few c.c. of acid in excess does not affect results. After precipitation of casein is complete, the mixture is diluted to the 200 c.c. mark, shaken vigorously ten or fifteen seconds and then filtered through a dry filter. The filtrate

should be clear. One takes 100 c.c. of the filtrate and from a burette adds $n/10$ NaOH until the neutral point is reached. The presence of phosphates may tend to obscure somewhat the end-point, but a little care enables one to get within a drop of the neutral point. The percentage of casein is calculated from the obtained results as follows: Divide the number of cubic centimeters of acid used by 2, subtract from this the number of cubic centimeters of alkali used to neutralize 100 c.c. of filtrate and multiply the result by 1.096. By using 22 c.c. of milk, the difference between one half of acid and of the alkali gives percentage directly without multiplying by a factor. The method gives satisfactory results when carried out with proper care. A determination can be completed in twelve to fifteen minutes, a half dozen or more can be made in about forty-five minutes when all conveniences are at hand and the manipulations are well under control.

The Determination of Nitrates in Potable Waters with High Chloride Content: J. PEARCE MITCHELL.

The conditions most favorable for the use of the "phenol-sulphonic acid method" were found to be: care in preventing evaporation of sample to complete dryness in the water-bath, prompt addition of the acid, use of an excess of acid (1.5 c.c. at least), and allowance of time for the completion of the reaction with the acid before dilution. Standards prepared according to Mason's suggestion gave the best results. With the reduction method the Cu-M couple in the presence of an excess of oxalic acid (0.5 g. per 100 c.c. of sample) was used. Reduction was complete in fourteen hours. The NH_3 is best determined by distillation, and nesslerization of the distillate. In the case of very high nitrate content the distillate is better collected in a standard acid solution. From laboratory experiments with solutions of known concentrations, and from the analysis of fifty-one samples of natural water by both methods, it appeared that the reduction method gave the better results with low nitrate content.

The procedure recommended is to use the reduction method for routine work; if the nitrate content is found to exceed five parts per million to repeat the determination, using the "phenol-sulphonic acid" method and, if the chlorides exceed ten parts per million, standards prepared according to Mason's suggestion.

The Normal Chloride Content of the Surface Waters on the San Francisco Peninsula: J. PEARCE MITCHELL.

From an area of 650 square miles 250 samples were collected at different seasons from 126 points. High chloride content, as compared with eastern waters, and wide local variations were found. Actual values varied from 9 to 50 parts per million in unpolluted streams. Discussion of the general climatic conditions, rainfall and ocean winds as factors leading to high values. Consideration of the topography, character of vegetation, exposure to ocean winds and wide local variations in rainfall (15–50 inches) as factors producing great local variations in normal chloride values. Emphasis of importance of study of local conditions, determination of local standards, and need of caution in interpretation of analysis from regions not investigated.

The Relation between the Calcium and the Fat Content of Cream: HERMANN C. LYTHGOE and CLARENCE E. MARSH.

This work was undertaken with the view of finding the maximum amount of calcium present in cream beyond which adulteration could be declared. The samples used were known purity samples, the cows having been milked and the cream separated in the presence of an inspector or analyst of the Massachusetts State Board of Health, samples separated from milk collected by the inspectors, and commercial samples found free from sugar by the Baier & Neumann reaction.

The calcium was found to decrease as the fat increased and the figures were plotted. From the plot the following results were taken:

Fat Per Cent.	CaO Minimum Per Cent.	CaO Maximum Per Cent.
50	0.057	0.092
45	0.070	0.103
40	0.082	0.117
35	0.095	0.130
30	0.107	0.142
25	0.119	0.154
20	0.132	0.168
15	0.144	0.180
10	0.156	0.192

The Determination of Benzoic Acid in Food Products: EDMUND CLARK.

The method proposed for the determination of benzoic acid consists in utilizing both ether and chloroform as extractive agents as follows: An aliquot portion of the filtrate, obtained by filtering a weighed amount of the substance which has been mixed with water and made up to a definite volume, is acidified with HCl and shaken out with

three 100 c.c. portions of ether. The unwashed ether extract is distilled rapidly over steam or by electric stove to the volume of about 5 c.c. and the residue exhausted by a current of air. This extract is dissolved in a little alkaline water and, after transferring to a Squibb separator and acidifying with hydrochloric acid, is shaken out with 40, 30, 20 and 10 c.c. successive portions of chloroform. The chloroform extract is washed with 30 c.c. water and transferred to a suitable container to which is added 100 c.c. recently boiled water and a few drops of phenol-phthalein.

The mixture is then titrated with N/20 NaOH, shaking well after each addition of alkali. Each cubic centimeter of N/20 used has a benzoic acid value of .0061. A correction is made for blank chloroform water mixture. The necessity for using ether will not arise when chloroform will readily make the extraction.

The advantages of the method are as follows: First, economy in time and in recovery of solvents; second, avoidance of tenacious chloroform emulsions; third, interfering organic acids eliminated; fourth, loss of benzoic acid reduced to a minimum.

The Determination of Sucrose and Lactose in Sweetened Chocolate: W. D. Bigelow and M. C. Albrech.

The method is proposed to obviate the difficulties ordinarily experienced in the extraction of fat preliminary to the determination of sugar and in the volume of the lead precipitate. A normal weight of the sample (26 grams per Ventske instrument) is placed in a 100 c.c. sugar flask, 90 c.c. of water added and the flask heated with occasional shaking in a water-bath. After the air in the flask is heated a stopper is inserted. When the temperature has reached 70 or 80°, 10 c.c. of basic lead acetate is added and the flask thoroughly shaken and allowed to cool. The mixture is then filtered and the clear liquid polarized and its specific gravity taken. From a table the amount of sucrose is read off from the polarization alone. In the presence of lactose the solution is inverted and again polarized, this time at 86°.

Composition and Treatment of Lake Michigan Water: Edward Bartow and Lewis I. Birdsall.

A zone of pollution has been found to extend into Lake Michigan along the shore of Indiana and Illinois. All communities are not able to extend their water intakes beyond this zone of pollution or to divert their sewage as Chicago does. Filtration must be used to get a pure water. The average composition of the water was determined and experiments made to learn the action of various coagulents that may be used in connection with mechanical filtration.

Lime, sulphate of aluminum, sulphate of iron and sodium carbonate were used either alone or in combination.

The results showed the best results with sulphate of aluminum were obtained when 2½ grains per gallon were used. Two grains of lime could be substituted for one grain of sulphate of aluminum at a saving of $1.34 per million gallons. Sulphate of iron could replace the sulphate of aluminum at a further saving of $1.08 per million gallons. Special care must be taken, however, when lime or sulphate of iron is used.

The Examination of Dried Fish: B. H. Smith.

Cusk and haddock are often substituted for cod in boneless and shredded so-called "codfish" because of their low price and because the preparations made from these fish resemble those of cod, making the detection of the substitution a matter of some difficulty. Hake and pollock are less frequently used, primarily because the reddish color of the former and the brownish color of the latter indicate the presence of these fish.

In an attempt to differentiate chemically the several varieties of closely allied salted fish the body oils were extracted by means of carbon-tetrachloride from desiccated ground samples, representing, in the case of cod, variations of geographical origin and methods of curing, and the iodin number, the refractive index, and, in some instances, other determinations, were made. The iodin numbers in all cases were lower than those of the liver oils of the same variety of fish and even greater variability was evidenced. The results obtained by the Hanus method on the cod samples varied from 85 to 137, which wide range is believed to be due in part to the complex composition of the natural oil and in part to the oxidizing influence of the salting and drying process; the cod substitutes gave iodin numbers of from 112 to 120.

The refractive indices of the oils from the cod samples varied from 1.5020 to 1.5043 at 25°, and those of the other varieties of fish from 1.4890 to 1.5000 at the same temperature. The "reducing substances" of the fish, which were determined by the method of Williams, *Journal of Chemical Society*, LXXI., 649, who reported considerable variation in different varieties, were found in but small amounts and are apparently

without significance. The microscopical examination of the fiber promises little because of the variation in the fiber in fish of different sizes, and also in different parts of the fish.

Determination of Caffein in Coffee: A Comparison of the Hilger and Fricke Method with a Modification of the Gomberg Method: A. L. SULLIVAN.

Five grams of coffee were boiled with four separate portions of water; the combined filtrate treated with 5 c.c. of saturated lead acetate, filtered and washed and the filtrate freed from lead by means of hydrogen sulfide. The solution was evaporated to about 25 c.c., cooled and extracted in a separatory funnel successively with 50, 25, 25, 25 c.c. of chloroform. The combined chloroform extract was freed from chloroform and dissolved in about 25 c.c. of water ½ c.c. (1–5 H_2SO_4) and 20 to 25 c.c. approximately N/10 iodine solution added. The precipitate formed immediately and was allowed to stand for two hours. The solution was then filtered and washed with a dilute acidified solution of iodine (1 part N/10 iodine to 4 of water). The precipitate after standing for a few minutes was dissolved in sulphurous acid and water. The solution was heated until the iodine was driven off, allowed to cool and made slightly alkaline with ammonia. The volume should be about 25 c.c. The solution was again extracted with chloroform, using the same amount as before. The chloroform extract was then evaporated in a tared dish, dried in a water oven and weighed.

It was found that the extraction of caffein from its aqueous solution by chloroform was practically complete.

The results seem satisfactory and it is apparent that the method described is suitable for determination of caffein in coffee. The results are slightly higher than those obtained by the A. O. A. C. method.

The Relation of the Iron Content to the Color of Soils: F. K. CAMERON and W. O. ROBINSON.

A chemical examination of twenty typical red and yellow soils shows that iron oxides are the inorganic coloring matter of these soils. Manganese is present in amounts too small to contribute to the color.

The causes in color variations of iron-colored soils is sometimes ascribed to the presence of different hydrates of iron oxide. From the comparatively small variation in soil temperature in near localities where the two tints are present it is reasoned that this view is incorrect, and that the iron is in much the same state of hydration.

The color is shown to be due to a film of oxides of iron and aluminum, organic matter, silica, etc., surrounding the soil grains. By comparing the color of soils with the iron content and mechanical analysis, it is proved that the thickness of the film causes the variations in color, the thin film of the colored oxide causing the soil to appear yellow, while a thicker film gives a red shade to the soil. This view was confirmed by precipitating ferric hydroxide upon sands of different-sized grains and upon quartz flour, using such amounts as to keep the percentage of iron constant and vary the thickness of the film.

The following papers were reported by title:

A Chemical Study of the Interaction of Fermenting Manures and Ground Rock Phosphate: E. V. MCCOLLUM and W. E. TOTTINGHAM.

The Estimation of Organic Matter in Soils: G. H. FAILYER and W. H. WAGGAMAN.

The Relation of Moisture Content to the Heat Conductance of Soils: H. E. PATTEN.

The Element System of Nomenclature in Soil Chemistry: C. G. HOPKINS.

The Interpretation of Soil Analyses with Respect to Phosphoric Acid: G. S. FRAPS.

The Potash of the Soil: G. S. FRAPS.

The Oxidation of Organic Matter in the Soil: G. S. FRAPS and N. C. HAMNER.

The Constants of Pecan Oil: G. S. FRAPS.

The Hydrolysis of Salicyn by the Enzyme Emulsion: C. S. HUDSON.

No abstracts have been received for papers read before the sections of Fertilizer Chemistry, and the Industrial Chemists and Chemical Engineers. The titles follow:

FERTILIZER CHEMISTRY SECTION

F. B. Carpenter, chairman

J. E. Breckenridge, secretary

Potash Tests in Commercial Fertilizer: J. E. BRECKENRIDGE.

The Measurement of Crude Sulphuric Acid: F. B. PORTER.

The Corrosive Action of Alkaline Tank Water upon an Evaporation and a Remedy: R. H. FASH.

The Use of Wood Ashes in Commercial Fertilizers: R. H. FASH.

Preparation and Neutralization of the Ammonium Citrate Solution: J. M. MCCANDLESS.

The Needs of Texas Soils for Fertilizers: G. S. FRAPS.

The Scientific Preparation of Phosphate Samples for Chemical Analysis: P. D. YOUNGBLOOD.

The Effect on Insoluble Phosphoric Acid when Litmus, Corallin and Cochineal are used in Preparing Solution of Ammonium Citrate: G. A. Farnham.

The Availability of Certain Nitrogenous Manures: Burt L. Hartwell.

Moisture in Phosphate Rock of the Pacific: Carlton C. Jones.

INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

A. D. Little, chairman

B. T. B. Hyde, secretary

Limitations of Use of Starch as an Accelerator in the Fusion Method: C. K. Francis.

The Technical Determination of Caoutchouc in Guayule: Charles P. Fox.

Laboratory Reagents and C. P. Chemicals: Clarence Riegel.

Standard Hydrometers: Louis A. Fischer and N. S. Osborne.

The Temperature Work of the Bureau of Standards: C. W. Waidner.

On the Influence of the Temperature of Burning on the Rate of Hydration of Magnesium Oxide: Edward DeMille Campbell.

The Electrotitrimeter: H. P. Bishop.

The Present Status of the Chemistry of India Rubber: W. C. Geer.

Free Lime in Portland Cement—A Mill Study: Arthur G. Smith.

The Inspection of Material: J. E. Moore.

Bag-house Treatment of Blast Furnaces and Roaster Gases: W. C. Ebaugh.

Hygienic Significance of Sulphur in Illuminating Gas: F. E. Gallagher.

The Destructive Distillation of Coals for Illuminating Gas: An Experimental Study: Alfred H. White.

The Determination of Fat and Soap in Sewage and Sewage Effluents: L. P. Kinnicutt.

Observations upon the Direct Determination of Carbon in Various Steels: G. W. Sargent.

Determination of Nitrates in Potable Water: Robert Spurr Weston.

The Ash of Coal and Its Relation to Actual or Unit Coal Values: S. W. Parr and W. F. Wheeler.

The Analysis of Asphalt and Asphaltic Compounds: S. W. Parr, Brainerd Meras and D. L. Weatherhead.

A Series of Parallel Determinations with the Mahler and Parr Calorimeters: S. W. Parr and W. F. Wheeler.

Further Application of the Specific Gravity Method for Determining Fat: Chas. H. Herty and E. J. Newell.

Some New Extractives for Use in Determining Fats: Chas. H. Herty.

Some Technical Applications of Titanium: Isador Ladoff.

The New Brady Gas Apparatus: William Brady.

A New Oil Gas Producer: A. B. Davis.

Manganese in Steel—a note: A. Auchy.

The Analysis of Lead Arsenate for Water Soluble Impurities: Roger C. Griffin.

The Bouquet of Wine and Beer: N. H. Claussen.

The Importance of Pedigree Cultures of Barley for Brewing Purposes: A. Nilson.

The Decomposition of Calcium Carbonate by Steam: Warren K. Lewis.

The Structure of Tin Plate as Determined by its Method of Manufacture: Wm. H. Walker and Warren K. Lewis.

Paint and Varnish Coatings as Accelerators in the Corrosion of Metals: Wm. H. Walker and Warren K. Lewis.

Convenient Illuminator for the Microscopic Examination of Opaque Objects: Wirt Tassin.

Copper-clad Steel—A Recent Metallurgical Product: Wirt Tassin.

A Simplified Combustion Crucible: P. W. Shimer.

Note on a Convenient Condenser for Extractions: David Bloom.

Barium and Sulphur in Fluorspar: H. G. Martin.

Cyanidation of Silver Minerals: Theo. P. Holt.

The Preparation of Sodium Oxalate for Use in Standardizing: John T. Baker.

Commercial Aspects of Peat as a Source of Chemical Products: Charles A. Davis.

Estimation of Pyridine in Aqueous Ammonia: A. C. Houghton.

Studies in the Solubility of Portland Cement: G. G. Wheat.

The Twitchell Process of Glycerine Recovery as Compared with the Ordinary Soap-kettle Saponification: O. T. Joslin.

Vacuum Evaporation: Philip B. Sadtler.

The Consumption of the Common Acids in the United States: Charles E. Munroe.

The Dynamic Explosion of a Water Filter: Charles E. Munroe.

B. E. Currie,
Press Secretary

Transmitted by Charles L. Parsons,
Secretary

(To be concluded)